THE HEATING AND VENTILATING MAGAZINE

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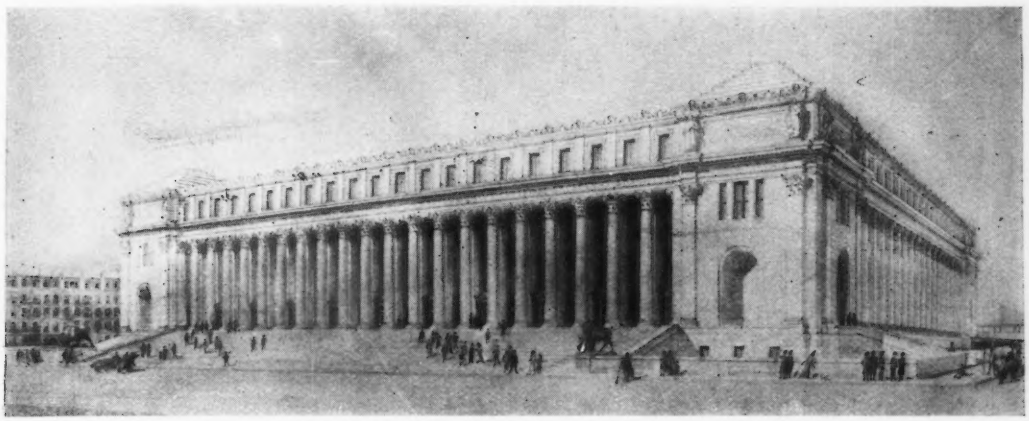


NEW YORK GENERAL POST-OFFICE, EIGHTH AVENUE AND 32D ST., NEW YORK.

Heating and Ventilating Details of the New York General Post-Office

On the opposite side of Eighth Avenue, directly across from the New York passenger station of the Pennsylvania Railroad, stands, in an almost completed condition, the building which is to become New York's general post-office.

The edifice is constructed of Milford granite and possesses a massive and imposing exterior. It will probably be ready for occupancy early in 1913, at which time a large part of the business that is now handled in the present old post-office at City Hall Square will be transferred to this new location.

The building was designed bv McKim, Mead & White, New York, and is divided on the ground floor into a wide corridor for public use, located just back of the front collonade, while in the rear of this corridor and in the basement, the space is mainly used for the sorting of mail. Behind the building is a private driveway where mail wagons can drive up and load or unload their contents unhampered and without interfering with the street traffic. The entire structure is supported on steel columns carried down to the Pennsylvania Railroad tracks (which run directly under the building) with mail platforms and lifts for loading and unloading the mail from the trains.

On account of the extent of the heating and ventilating system for this building, the illustrations given are devoted to details of the plant.

General Arrangements.

The heating system is designed to warm the east foyer, pavilions and main workroom under the court skylight on the first floor, together with the east rooms and pavilions on the second and

third floors, by indirect heating; the balance of the building is heated by direct radiation. Steam is used to supply all indirect radiation and the direct heating between the glass roofs of the court; all the other direct radiation is supplied by hot water.

The warming of the air for ventilation purposes is accomplished by means of two groups of heaters, each of which is composed of a primary and secondary heater, between which is placed an air washer. Each group of heaters is connected to two fans which draw the air in through the fresh air intakes and propel it through the distributing ducts to the various points desired. A general arrangement of one group is illustrated herewith (Fig. 1).

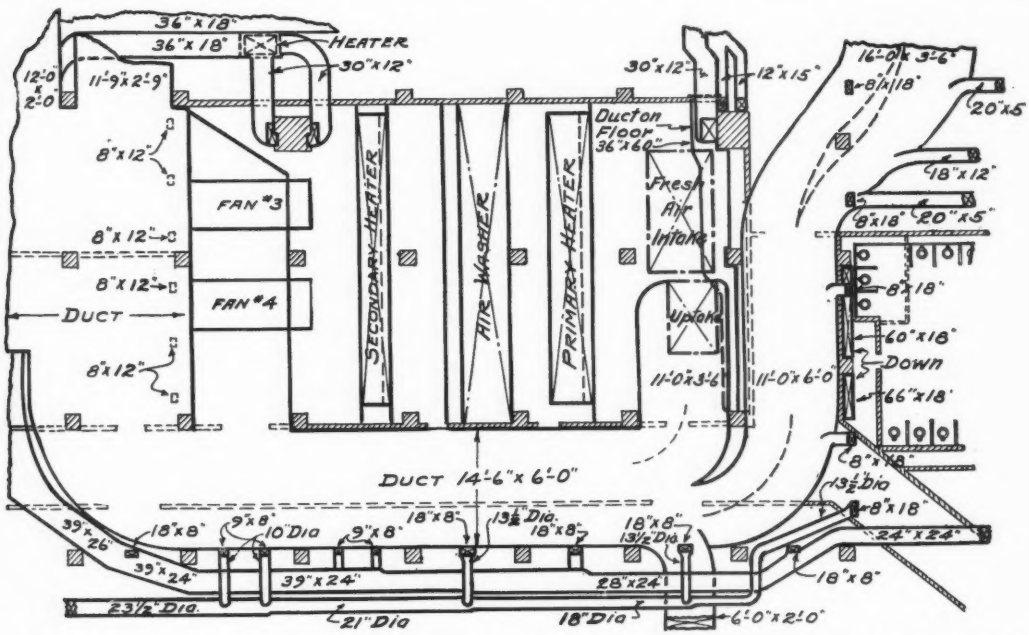


FIG. 1.—ONE OF THE HEATER GROUPS, COMPOSED OF PRIMARY AND SECONDARY HEATERS, AIR WASHER AND FANS.

For purposes of indirect heating, a portion of the ventilating air is reheated as it passes through the ducts by tertiary or third heaters, one of which is provided for the first floor foyer and pavilions, two for the second and third story east rooms and pavilions, and fifteen for the first floor court enclosure, or workroom. These tertiary heaters are shown in plan and elevation in Figs. 2 and 3.

The discharge of the vitiated air is effected by special fans which remove the air from the east foyer and discharge it into the east basement, discharging the air from the basement outboard. The discharge of air from the court outboard is accomplished by fans in the monitor roof and also by auxiliary fans discharging air from the court into the building platform space. In general, the ventilation of the remainder of the building (except the toilet room) is provided for by collecting vertical flues of sheet metal, which are located on the outside and court walls and which discharge air from all rooms and apartments (not otherwise provided for) into the attic space, whence it is driven outboard by two groups of fans. The arrangement of a typical group of air and exhaust ducts is shown in Fig. 4. The toilet room venting is largely cared for by vents in the fixtures which are connected to exclusive collecting pipes that lead to independent fans in the attic which discharges the air outside. A layout of one of the basement fan rooms, No. 8, is given in Figs. 5 and 6, and a typical skylight ventilating fan is shown in Fig. 7.

Steam Supply.

The steam supply is furnished temporarily by the New York Edison Co., which in turn buys it from the Pennsylvania Station service plant from one of

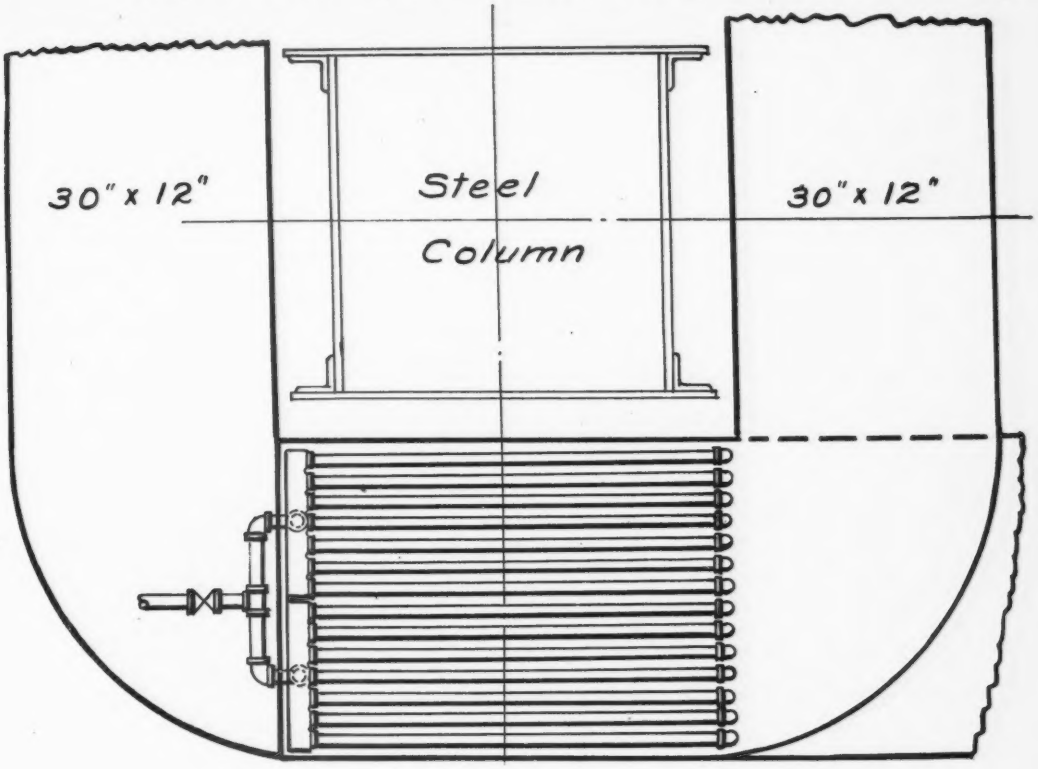


FIG. 2.—TYPICAL PLAN VIEW OF TERTIARY COILS.

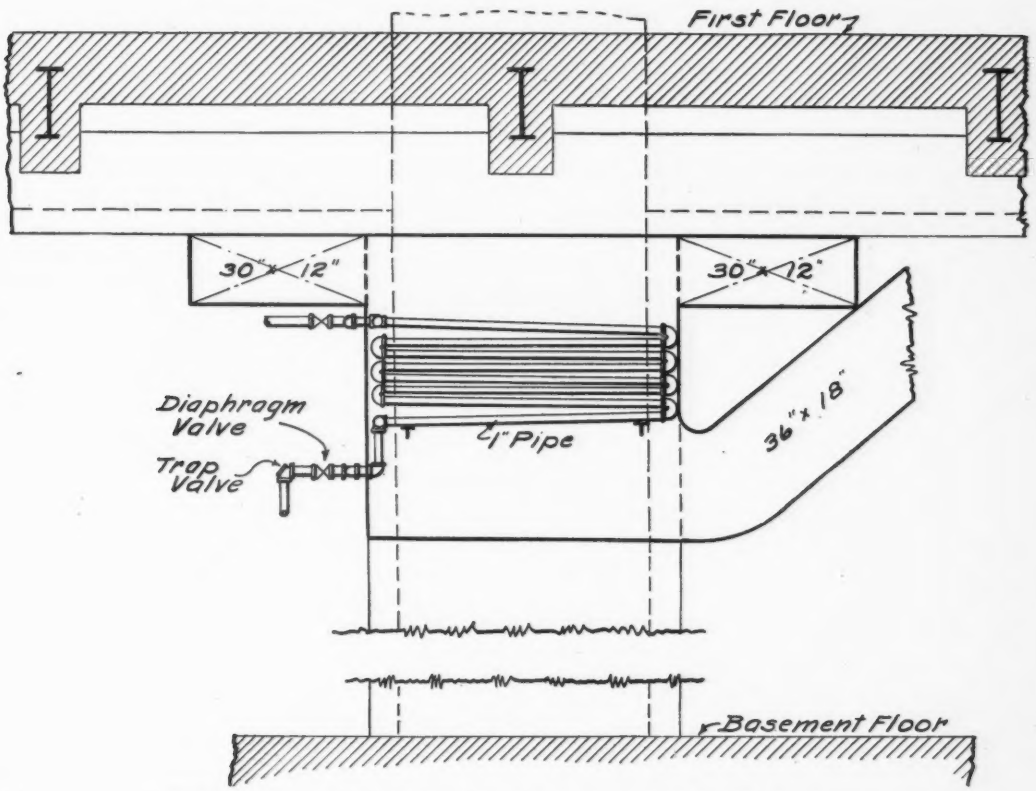


FIG. 3.—TYPICAL ELEVATION OF TERTIARY HEATER.

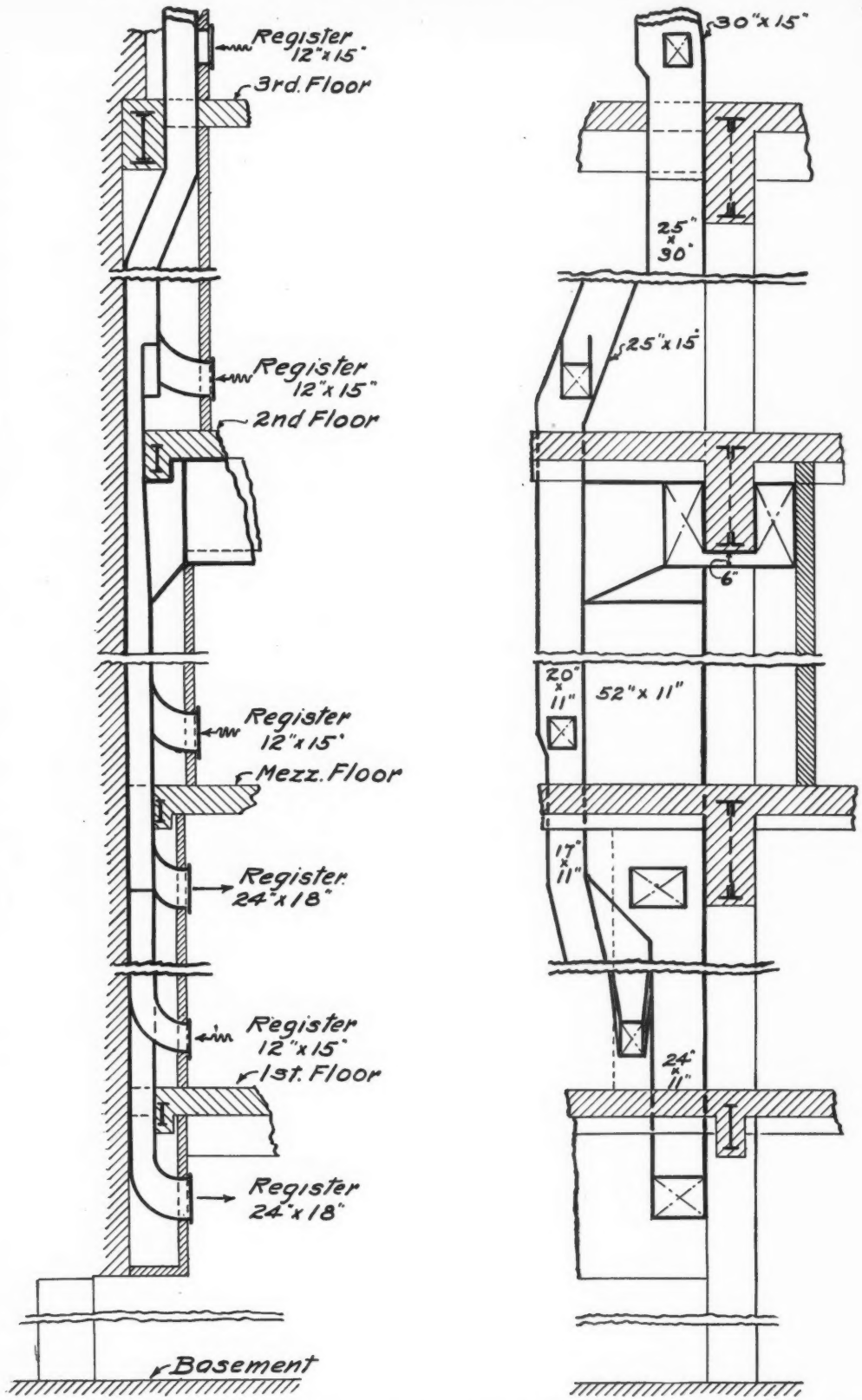


FIG. 4.—TYPICAL ARRANGEMENT OF VENT AND FRESH AIR FLUES AROUND COLUMNS.

their station lines. It is the intention, however, for the Edison Co. to build a power plant for this work in the near future.

A primary reducing valve is installed on the 8-in. high pressure steam main, where it enters the building which immediately cuts the pressure down to 50 lbs. per sq. in. and on each of the steam pressure branch mains is placed a secondary reducing valve which lowers the pressure from 50 to 20 lbs. These branches consist of the supplies to the primary and secondary heaters, the supply to the fifteen tertiary heaters beneath the court, the tertiary heater for the foyer, the tertiary heaters for Fans No. 7 and No. 8, the supply to the hot water generators and the supply to the skylight coils. The reducing valves are all equipped with alarm whistles on the low pressure side combined with pop safety valve.

The steam supplies to the skylight coils are run to the under skylight space through air ways about the columns in the court and are connected by branch runouts having diaphragm valves and thermostatic control.

Throughout the piping system expansion on both steam and hot water lines is provided for by expansion loops as far as posible, and all pipe was cut of such length as to produce a tensile stress in the pipe (when erected cold) equal to the compressive stress produced (when hot) under conditions of maximum service.

The overhead condensation return piping is designed for open drainage service, having (for this purpose at the ends of all runs and at intervals of about 60 ft. throughout the length of the return runs) tee fittings for 1-in. pipe with the center top outlet looking up. Into each of these outlets is inserted a 1-in. vertical pipe about 12 ins. high, with a swing check at the top, which opens inward and has the tongue hanging perpendicularly when free. This is for the purpose of admitting air to follow and break up any flow of water in "plugs," thus preventing hammering and also all outward flow.

Condensation returns are run into a receiving tank 60 in. in diameter and 96 in. long, have ¼ in. thick boiler iron shell and ⅜ in wrought-iron concave head.

The two discharge pumps are of the volute pattern with 2 in. discharge nozzles, running 1200 R. P. M. and driven by a direct-connected 2 H. P. motor, pumps and motors mounted on a single cast-iron bed plate set on a concrete foundation.

The 2-in. vapor pipe from the receiving tank is run through a condenser consisting of a cast iron tank 24 ins. in diameter and 60 ins. long with flanged ends and bolted convex head plates, one of which is bored at the bottom for a 5-in. cold water infeed connection and the other at the top for a similar size tempered water outlet. Inside of this tank is placed a trombone coil of heavy 1-in. copper pipes, and the tank is so suspended in a horizontal position above the receiving tank that the branch manifolds are in a horizontal position. The 2-in. vapor line is run into the lower manifold top forcing the vapor through the coil and out of the top manifold top to the pipe leading to the atmosphere. The top of the condenser shell is air vented and a 12-in. drain pipe is connected to the bottom. The cooling water used is the cold water supply on its way to the hot water service heaters.

Direct Hot Water System.

The hot water radiation is supplied by two hot water generators, heated by steam, and each generator is connected to the discharge of a centrifugal circulating pump. From these pumps and generators, the heated supply is carried up to the attic where it is distributed horizontally to the vertical drops which are carried down the inner faces of the outside and court walls connecting to the hot water radiators as required, the chilled returns being continued on down to the basement where they are connected to the suction sides of their respective circulating pumps to repeat the cycle of movement. Figs. 8, 9, 10, 11 and 12 give the various methods employed for radiator connections used in the different portions of the building.

The two hot water generators are both of identical size and description, each having a capacity of heating 40,000 gals. of water per hour from 180° to 200°

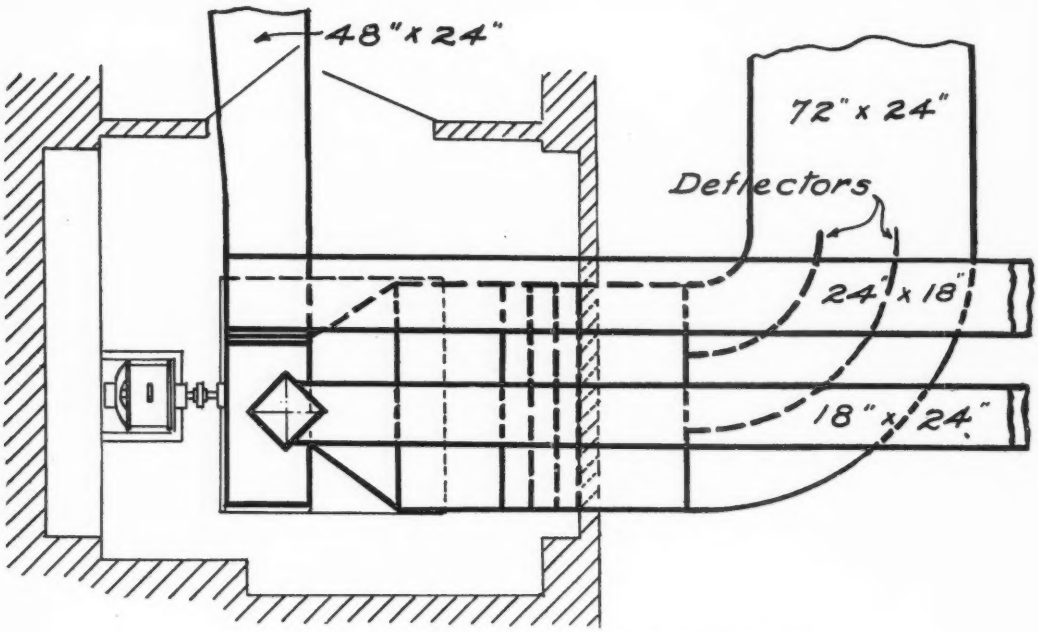


FIG. 5.—PLAN VIEW OF BASEMENT FAN ROOM NO. 8.

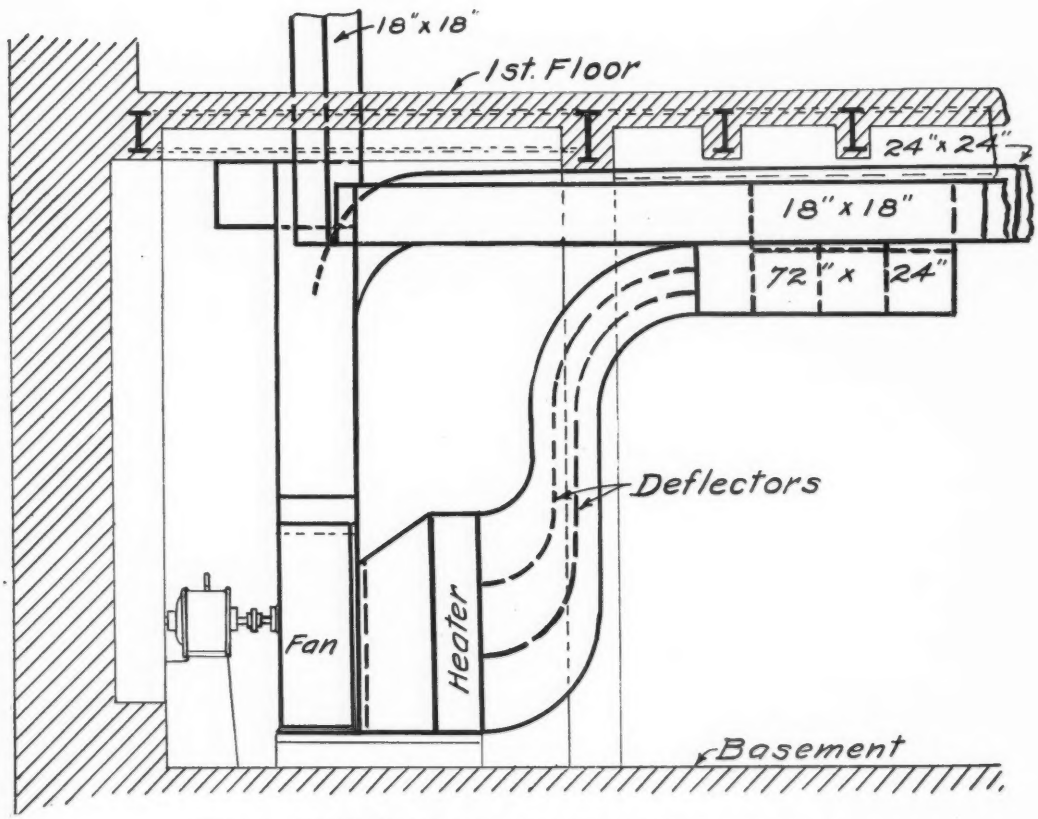


FIG. 6.—ELEVATION OF BASEMENT FAN ROOM NO. 8.

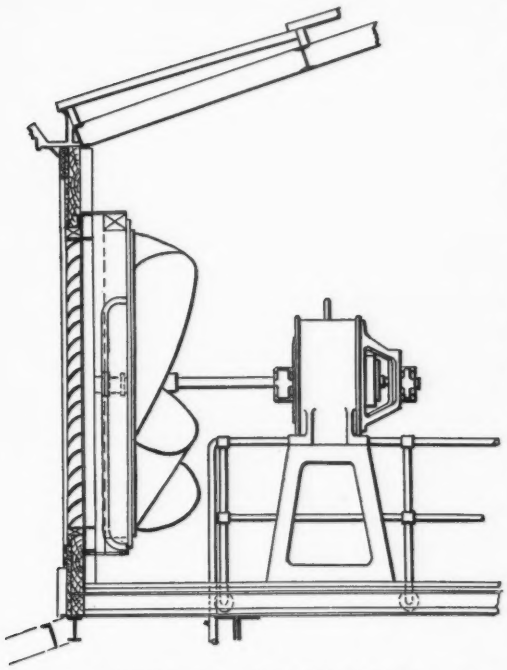


FIG. 7.—TYPICAL ARRANGEMENT OF SKYLIGHT VENTILATING FANS.

F. when furnished with steam at 10 lbs. pressure. They are of vertical type, with a cast-iron shell serving as a steam chamber inside of which are placed pure copper tubes through which the water is circulated. Approximately these heaters are 10 ft. high over all, about 28 ins. diameter, and each contains about 400 sq. ft. of copper tubing exposed to the steam surfaces.

These generators have an 8-in. opening near the top for steam (with an 8-in. x 5-in. reducing flanged nozzle) and a 2-in. condensation drip connection near the bottom. The water inlets and outlets are made with 7-in. x 5-in. reducing flanged nozzles. Safety valves are provided for excessive steam pressure relief, and 5-in. diaphragm valves are inserted in the steam supply lines.

The turbine circulation pumps have a capacity each of 700 gals. per minute, against a total friction head of 25 ft. and have the discharge ends connected to the inlets of the hot water generator. These pumps are motor driven by 10 H. P. motors, direct-connected through flexible couplings. Both the pumps and motors are set on concrete foundations, reinforced with three 6-in. I-beams set in mid-vertical position and running t right angles to the floor beams, so as to cover and bear on three of the structural beams, thus dividing the load between them, and the foundations are raised to pump discharge at the same elevation as the inlet into the hot water generators.

In general, the hot water piping is so graded that the air travel is uninterrupted by any obstruction except radiators in the entire run from the lowest points in the basement to the highest point in the attic. The main hot water riser and all the drops are securely anchored at the middle point, so as to make the expansion both upward and downward.

The feed drops on the hot water system are made with a Y branch tee at the top, the Y connecting with the branch main, the lower tap connecting with the drop and the upper tap closed with a plug in which is inserted an air valve. The drops are valved both at the top and at the bottom.

All the radiators used for direct heating are of American Radiator Co. make, and are of the water pattern.

An expansion tank having a storage capacity of about 60 cu. ft. is connected to the hot water heating system. This tank is built of 2-in. hard pine planking, reinforced with rods and stays, and is lined with 18 oz. sheet copper, with locked and soldered points. The copper lining is extended above the top of the tank, is there turned over and tacked to

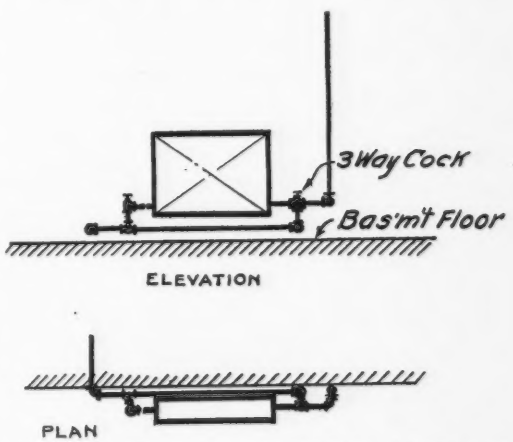


FIG. 8.—TYPICAL BASEMENT RADIATOR CONNECTIONS, NORTH AND SOUTH WALLS.

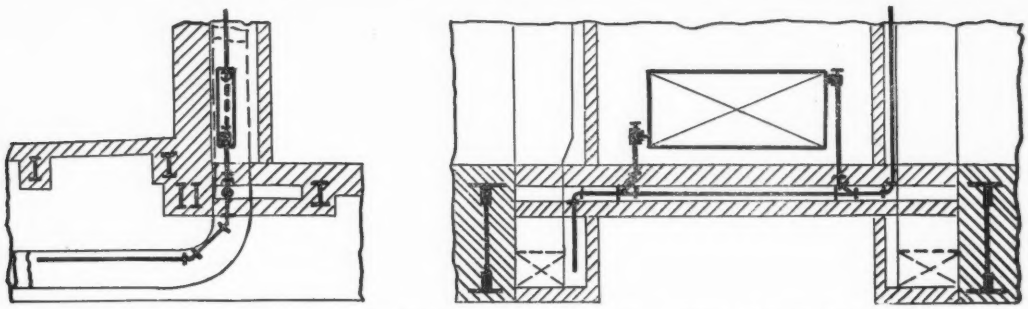


FIG. 9.—TYPICAL RADIATOR CONNECTIONS, ATTIC WEST WALL.

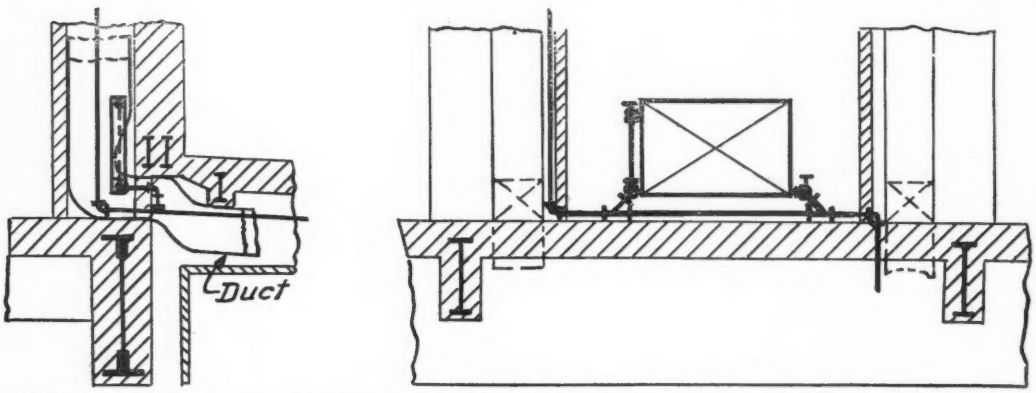
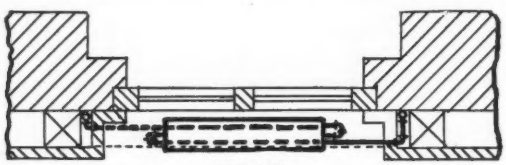


FIG. 10.—TYPICAL RADIATOR CONNECTIONS, ATTIC NORTH AND SOUTH WALLS.



PLAN.

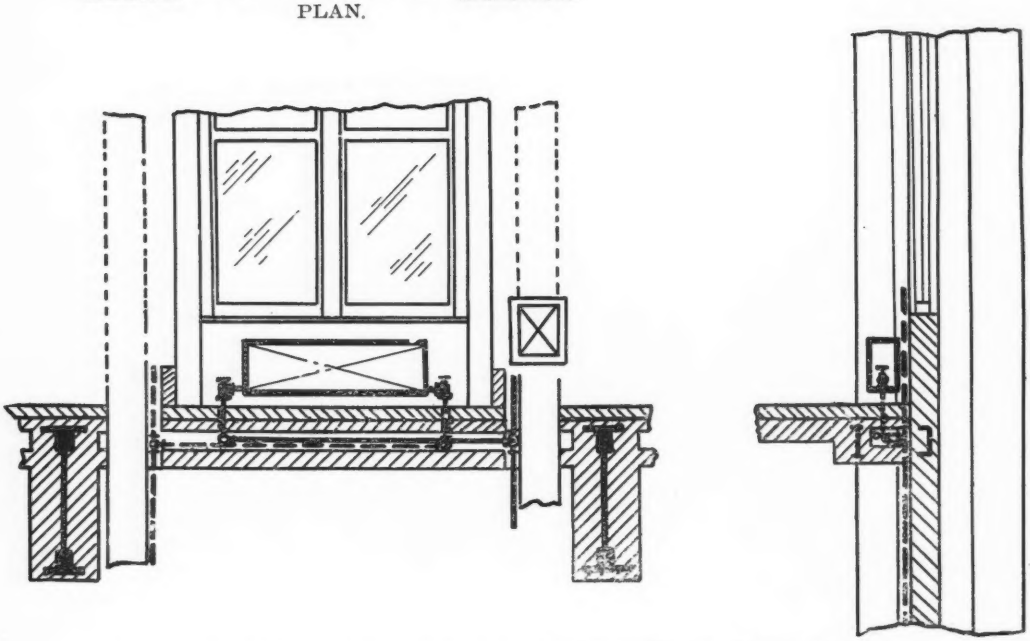


FIG. 11.—TYPICAL RADIATOR CONNECTIONS, OUTSIDE WALLS.

the outside planking. The tank is supported on 4-in. I-beams, which are in turn carried by two 8-in. I-beams supported by the roof trusses. A 2-in. expansion pipe without valves is run from the 8-in. chilled water return main (near the suction end of the centrifugal pumps) to the bottom of the expansion tank where a heavy copper wire ¼-in. mesh basket screen is placed. The overflow consists of a 2½-in. pipe brought into the bottom of the tank and terminated in a 6-in. 16 oz. copper funnel with a wired rim located so as to bring its upper edge 2 ins. below the top of the tank.

An altitude gauge is located in the hot water generator room and is connected direct with the expansion tank by ½-in. pipe.

The water supply to keep the hot water system filled is of 2 ins. in size and is brought from the house tank through a 1½-in. centrifugal pump located near the expansion tank and operated by a ½ H. P. direct-connected motor at 1080 R. P. M. delivering the water into the expansion tank through a 2-in. pipe with ¼-in. perforated holes and extended along one entire side of the tank. The operation of the motor and pump is controlled by a float switch adjusted so as to start the motor when the water falls to within 2 ins. of the bottom of the tank and to stop it when it rises to within 6 ins. of the top.

Drainage for the hot water system is taken care of by the connection of a 2½-in. pipe into the lowest point of the main return, this pipe being run to the suction end of the 2-in. centrifugal pump which drains the south air washing tank (discussed further on) with a valve to allow the draining of the hot water system whenever desired. The drains from the hot water generators, primary, secondary and tertiary heaters are also run into this 2½-in. drain pipe, with the necessary valves to allow drainage of any of these at pleasure.

Valves.

Air valves are installed on the extremities of all steam mains; these being of specially large type to insure quick and sure action in air relief. These valves are vent-connected into the open returns, finally reaching the receiving tank. The 12 main returns from the primary and secondary heaters are also similarly vented. The water mains in the attic are vented through a 2-in. inlet automatic lever and float air trap with copper floats and having a ½-in. air vent pipe carried for discharge into the expansion tank.

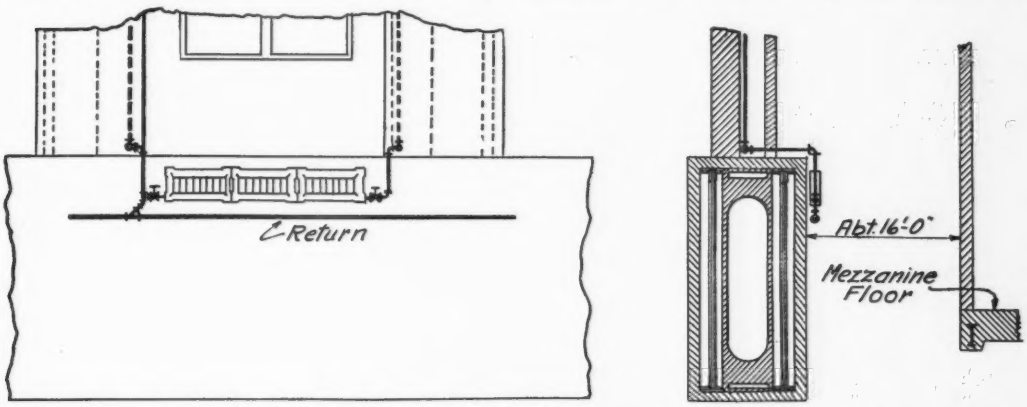


FIG. 12.—TYPICAL WALL RADIATOR CONNECTIONS ON EAST AND WEST WALL, MEZZANINE.

The basement radiators are connected as shown in Fig. 8, and where indicated feed from a three-way cock valve of open flow-way pattern.

Fans.

There are 31 fans in all. Those furnished by the Massachusetts Fan Co., Watertown, Mass., are as follows:

Nos. 1, 2, 3, 4, are 90-in. full-housing steel-plate fans and have a capacity of 75,000 cu. ft. of air per minute at a speed of 136 R. P. M.

No. 5.—160-in. full-housing steel-plate fan. Capacity, 35,000 cu. ft. at 170 R. P. M.

No. 6.—160-in. full-housing fan. Capacity, 30,000 cu. ft. at 150 R. P. M.

Nos. 7 and 8.—90-in. full-housing steel-plate fans. Capacity each, 100,000 cu. ft., of air per minute at 303 R. P. M.

Fans No. 9 to No. 21 inclusive were furnished by Howard & Morse, Manufacturers of the Blackman fans, New York.

Nos. 22 and 23. No. 2 squirrel cage fans. Capacity each, 35,000 cu. ft. of air per minute at a speed of 475 R. P. M.

No. 24. No. 3½ squirrel cage fan. Capacity, 12,500 cu. ft. at 350 R. P. M.

No. 25. No. 1¼ squirrel cage fan. Capacity, 950 cu. ft. at 425 R. P. M.

Nos. 26, 27 and 28. No. 1¼ squirrel cage fans. Capacity each, 1300, 1740 and 1520 cu. ft. of air at speeds of 1000 R. P. M.

No. 29. No. 1½ squirrel cage fan. Capacity, 1900 cu. ft. at 900 R. P. M.

Nos. 30 and 31. No. 2 squirrel cage fans. Capacity each, 3800 cu. ft. of air per minute at a speed of 400 R. P. M.

The motors for all of these fans were furnished by the C. & C. Electric and Manufacturing Co., New York.

There are about 12 of the larger duct dampers which are pneumatically controlled, while most of the other dampers are rand set.

Temperature Control.

Temperature control is provided for the air passing through the primary, secondary and tertiary heaters and for the heating surface between the upper and lower glazing of the court skylight.

For this purpose there are used two electrically operated air pumps (each capable of compressing 10 cu. ft. of air at 30 ins. and 62° F. to 5 cu. ft. at 60 ins. and 62° F), a compressed air reservoir of about 60 gal. capacity and other necessary apparatus. There is also a telethermometer placed in the hot water generator room which indicates on a dial the temperature of the air entering the intake shaft, in the washer room, in the tempered ducts between the secondary and tertiary heaters, in the uptakes for two of the fans water in the hot and chilled mains of the direct heating system, the air in the main foyer, in a typical room on the second floor east. This enables the operator to keep in touch with practically the entire heating and ventilating system without leaving the hot water generator room and gives immediate notice of anything out of the ordinary which affects the temperatures.

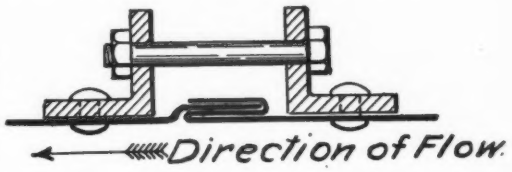


FIG. 13.—METHOD OF MAKING JOINTS IN GALVANIZED IRON DUCTS WITH 4 SQ. FT. OR MORE AREA.

Covering.

The heating and ventilation of this building was designed by L. M. Marks and J. E. Woodwell, consulting engineers, New York, and is being installed by Baker, Smith & Co., New York.

Building Heated by Pipes Under Floor

Heating a building by means of steam pipes embedded in the concrete floor has been successfully accomplished in the chassis testing building of the Moline Automobile Co., at Moline, Ill. The structure is 120 ft. long by 60 ft. wide, with door openings extending completely across the ends of the building.

The workmen are obliged frequently to lie on the floor in making necessary repairs and adjustments and on this account it was desired to keep the floor surface comfortably warm. To accomplish this, 1 ¼-in. steam pipes, spaced 42 in. on centers were laid 2 in. below the surface of the 6-in. floor slab. The concrete is reinforced locally against cracking, due to the expansion of the steam pipes, by corrugated, galvanized iron pipes inclosing the former.

Below the floor slab, 8 in. of cinder fill are placed as an insulating material. It is stated that with only five small metal radiators additional, it is possible to obtain a uniform temperature of from 60 to 70 deg. F., throughout the building.

Radiation Formula for House Heating

By Charles F. Smith.

An interesting formula, accompanied by tables of constants, for use in estimating the required radiation for residences, is presented by Charles F. Smith, of Cincinnati, O., in the course of an article in the National Builder on the heating of the modern home.

The formula is based on one change of air per hour in living rooms and bed rooms and three changes per hour in halls. In large living rooms or parlors, two air changes per hour, he states, should be provided for. Mr. Smith's formula is as follows:

B. T. U. required = $W \times K + G \times L + C \times N \times T +$ a certain percentage for exposure in accordance with the following diagram.

In the formula:

W = net wall area.

K = a constant for different forms of wall construction in accordance with Table 1.

G = glass surface (full size of window openings).

L = a constant in accordance with Table 2.

C = cubic contents of room.

N = number of air changes per hour.

T = a constant in accordance with Table 3.

If there is a cold space above or below the room, the surface area of the ceiling, or floor, should be multiplied by the constant R or S, as the case may be, as per Table 4, and the quotient added to the previous total.

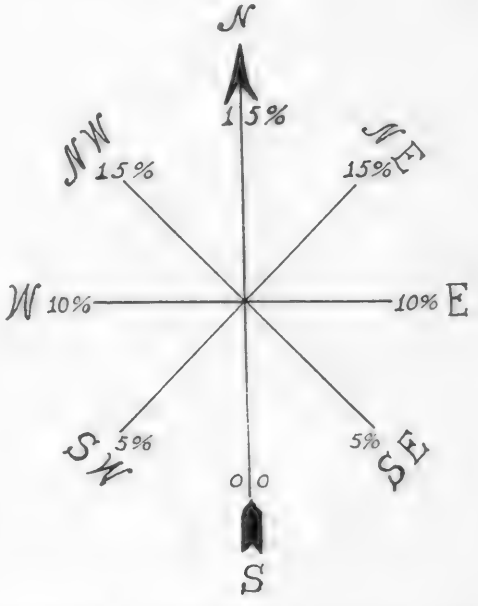


DIAGRAM OF HEAT UNITS TO BE ADDED FOR DIFFERET EXPOSURES.

TABLE 1 (K).

Heat losses in B. T. U. through walls of brick or frame, with differences in temperature of outdoor and indoor air of

	40°F.	45	50	55	60	65	70	75	80
Brick walls, lathed and plastered inside.									
4 in. thick	12	13	14	16	17	18	20	21	22
8 in. thick	10	11	12	13	14	15	16	17	18
12 in. thick	8	9	10	11	12	13	14	15	16
16 in. thick	7.2	8.1	9	10	11	11.6	12.6	13.5	14.3
Clapboards or shingles	18	20	22	24	26	29	31	33	35
Clapboards, with paper	12	14	16	17	19	20	22	23	25
Clapboards, with sheathing	11	13	14	15	17	18	20	21	22
Clapboards, with sheathing and paper	9	10	12	13	14	15	16	17	18

All of above walls lathed and plastered inside.

TABLE 2 (L).

Heat losses in B. T. U. through windows and skylights, with differences in temperature of outdoor and indoor air of

	40°F.	45	50	55	60	65	70	75	80
Single glass	43.5	48	54.5	60	65.5	71	76	82	87
Double glass	24.7	27.8	31	34.1	37	40.2	43.4	46.5	49.6
Double window	18.4	20.7	23	25.3	27.6	29.9	32.2	34.5	36.8
Single skylight	46.5	52	58	64	70	75	81	87	93
Double skylight	19	22	24	27	29	31	34	36	39

TABLE 3 (T).

Specific Heat of Air, 0.2375.

Initial Temp. Deg. F.	Weight of Air per 1 Cu. Ft. Lbs.	B.T.U. to Raise 1 Cu. Ft of Air 1° F.	B. T. U. required to raise 1 cu. ft. of air from initial temperature (Col. 1) to final temperature of 60°F.	70	80	90	100	110	120	130	140	150
—20	0.0903	0.0214	1.716	1.931	2.145	2.36	2.575	2.789	3.004	3.218	3.432	3.647
10	0.0883	0.0209	1.468	1.677	1.887	2.096	2.305	2.516	2.725	2.935	3.144	3.354
0	0.0863	0.0205	1.23	1.435	1.64	1.845	2.05	2.255	2.46	2.665	2.87	3.075
10	0.0845	0.0200	1.003	1.204	1.405	1.605	1.806	2.006	2.207	2.408	2.608	2.809
20	0.0827	0.0196	0.786	0.982	1.179	1.375	1.572	1.768	1.964	2.161	2.357	2.554
30	0.0808	0.0192	0.576	0.768	0.960	1.152	1.344	1.536	1.727	1.919	2.111	2.302

TABLE 4 (R + S).

	Heat losses in B. T. U. through ceilings and floors (the space above considered as 40° F. and below as 35° F., with differences in temperature of 15°F.	20	25	30	35	40
Ceilings.						
Lathed and plastered	9.3	12.4	15.5	18.6	21.7	24.8
Lathed and plastered, double floors	2.7	3.6	4.5	5.4	6.3	7.2
Lathed and plastered, single floors	3.9	5.2	6.5	7.8	9.1	10.4
Floors.						
Single, not plastered	6.7	9	11.3	13.5	15.7	18
Single, lathed and plastered	3.9	5.2	6.5	7.8	9.1	10.4
Double, not plastered	4.7	6.2	7.8	9.3	10.9	12.4
Double, lathed and plastered	2.7	3.6	4.5	5.4	6.3	7.2

TABLE 5—ACTUAL VELOCITY OF AIR IN FLUE IN FEET PER MINUTE BY NATURAL DRAFT.

Hei't of Flue in Ft.	Temperature in Flue Above That of External Air, Deg. F. 5	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150
1..	24	33	42	48	54	60	67	75	81	88	95	101	108	113	118	122	127	132
5..	54	75	93	108	120	135	151	168	183	198	213	228	243	254	264	275	285	299
10..	78	108	133	153	171	198	216	247	266	288	308	326	342	358	374	388	404	419
15..	93	132	162	189	210	231	264	297	326	354	379	393	420	438	456	474	492	513
20..	108	153	189	216	243	264	306	342	376	409	435	460	483	504	525	547	569	594
25..	120	171	213	243	270	297	337	384	414	444	475	507	540	564	588	613	638	663
30..	132	189	234	264	297	324	372	420	460	498	533	565	594	620	647	673	700	726
35..	144	204	252	285	321	351	402	453	489	525	561	597	639	669	698	726	755	783
40..	153	219	267	306	342	375	429	483	532	576	616	652	684	717	750	780	809	838
45..	162	231	282	324	363	399	456	513	564	610	652	690	724	759	794	829	864	887
50..	171	243	297	342	383	419	482	541	595	644	688	728	765	801	837	873	908	937
60..	189	264	324	373	420	461	529	594	650	703	751	795	835	876	919	958	994	1028
70..	204	285	351	408	456	495	569	637	698	756	815	856	900	936	972	1008	1044	1083
80..	219	306	375	435	485	530	608	687	747	809	866	918	965	1012	1060	1108	1148	1185
90..	231	325	399	459	516	564	645	729	794	859	919	973	1022	1071	1116	1155	1196	1248
100..	243	342	420	486	530	594	680	768	842	910	972	1029	1080	1134	1188	1233	1276	1325

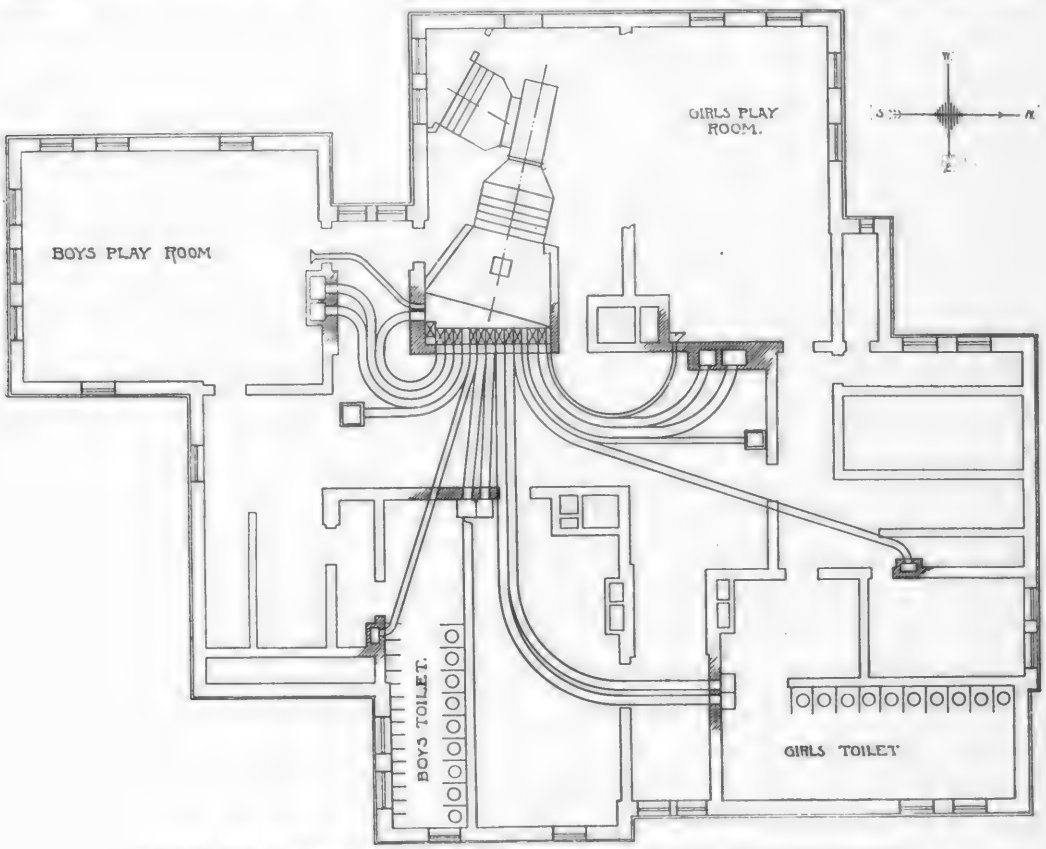
Downward Ventilation in a Rockford, Ill., School House*

By Clinton E. Beery.

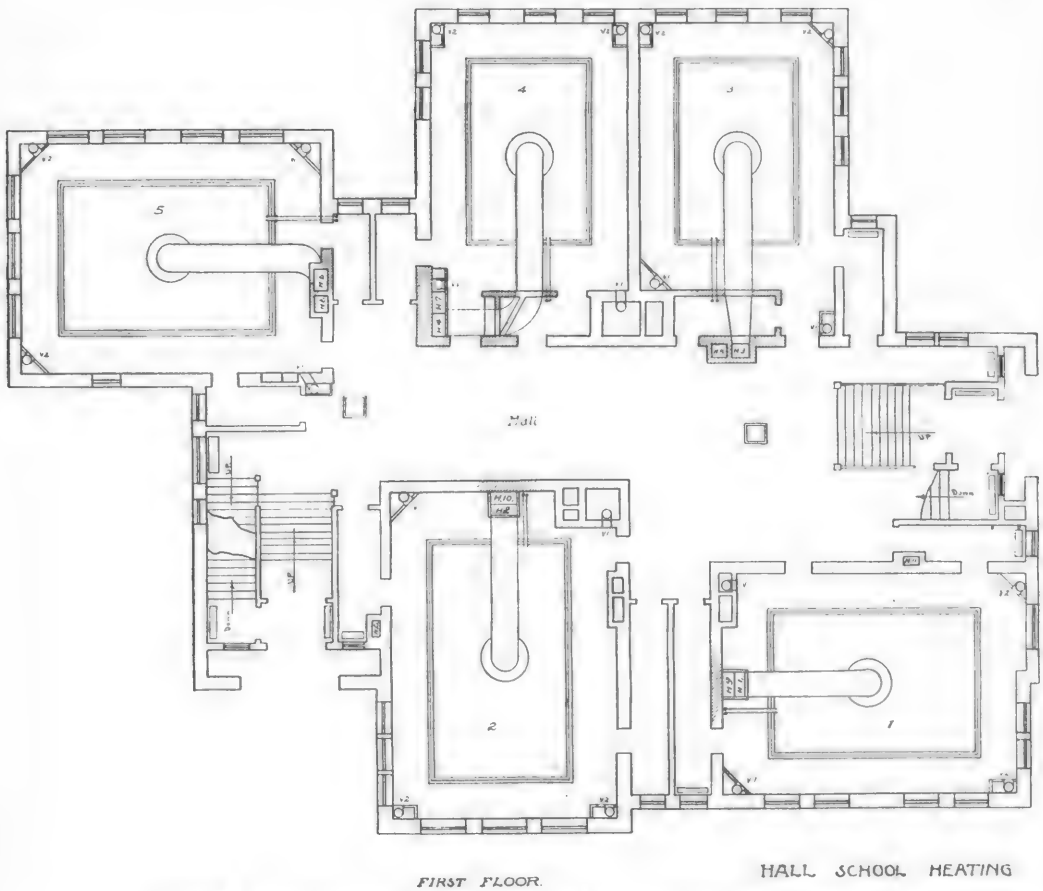
The system of heating and ventilation for the Hall School Building, Rockford, Ill., was designed by and installed under the supervision of the author last summer, and has been in operation since the beginning of the last school year. In view of the generally accepted theories of heating and of the revolutionary tendencies in the method designed by the author, together with what appears on first thought to be a freaky arrangement, he desires to make a brief explanation, believing it will help to convey a clearer understanding of the theory on which this method, which will be referred to hereinafter as the new method, operates. Incidentally, he has applied for a patent on the system.

*Read at the annual meeting of the American Society of Heating and Ventilating Engineers.

In the author's experience, based for the most part on practice and observation he became impressed with the importance of saving, if possible, the great heat losses frequently found in fan-blast heating and ventilation, which seemed to him not only a waste, but actually a handicap to good results. With the knowledge that air of lower temperature and greater density always finds a position at the floor, and that higher temperatures prevail at the ceiling, he reasoned that, if the temperature near the ceiling could be controlled by some means other than the ventilating apparatus, the air customarily at a high temperature at or near the ceiling could be held to a minimum difference in temperature between the floor and the ceiling, and in this way a beneficial influence



PLAN OF THE BASEMENT OF THE ROCKFORD SCHOOLHOUSE.



FIRST FLOOR PLAN OF THE ROCKFORD SCHOOLHOUSE.

could be produced on the results obtained from the ventilating apparatus.

With this as a basis for his theory he arranged, on January 3, 1912, a regular school room, referred to hereafter as room No. 3, for experimental work to demonstrate his theory. Several other rooms in the building were operating as in general practice. This was the first season for the heating and ventilating system, and it was giving good results.

Room No. 3, which is in the northwest corner of the first floor, is the coldest room in the building. Room No. 8 is on the second floor, directly over room No. 3, and is an exact duplicate of it. Each of these rooms is 26 ft. by 31 ft., with ceilings 13 ft. 6 in. high. Each has 100 sq. ft. of glass exposure facing the west, and 50 sq. ft. of glass exposure facing the north. All windows are protected with wood grooved weather strips. These two rooms were operated the remainder of the heating season, and more or less careful observations of their operation noted.

During the early part of January a comparative test was made of the temperature in room No. 3 (the new method) and room No. 8 (the regulation method), with 60 sq. ft. of wall radiation in the northwest corner. The air delivery in the rooms was 1,544 to 1,560 cu. ft. per minute, measured at the exits. Twelve temperature readings were taken at 5-min. intervals in each corner of both rooms. Twelve readings of the temperature of the entering air were also taken at 5-min. intervals. The outside temperature at the time of the first reading was 2° below zero F., and at the time of the last reading 3° below zero F. An extremely

cold west wind, estimated at 18 to 20 miles per hour, was blowing. The maximum and minimum temperature, Fahrenheit, of the twelve readings taken are given in the accompanying Table 1:

building isolated from any influence or conditions in rooms Nos. 3 and 8. The relative humidity readings in room No. 3 showed 63%, and in room No. 8, 54%.

TABLE I.—MAXIMUM AND MINIMUM OF ROOM TEMPERATURES DURING COMPARATIVE TESTS, DEG. F.

Room Number	Northwest Corner.	Northeast Corner.	Southeast Corner.	Southwest Corner.
3	70-67	71-70	70-68	69-67
8	83-80	70-68	69-66	69-64

The temperature of the entering air as per twelve readings, expressed in degrees F., at 5-min. intervals, are given in the accompanying Table 11:

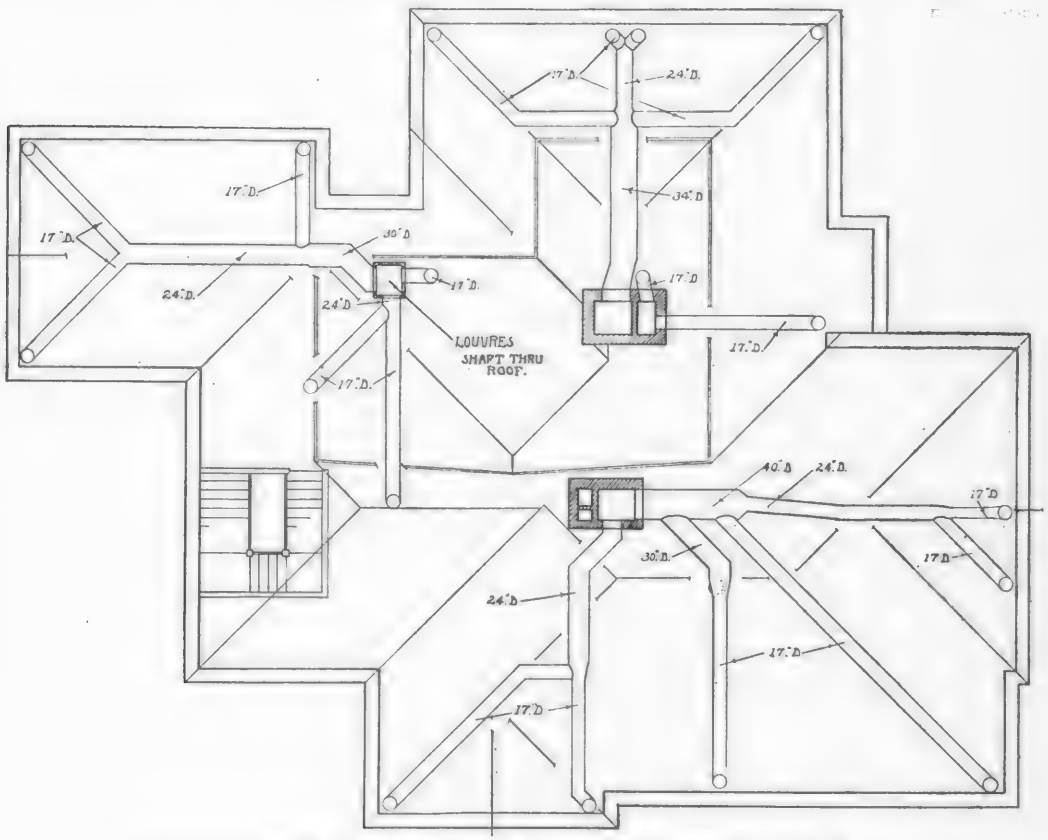
Observations of the relative time required to heat room No. 3 and room No. 8 to 68° F. were taken, with heat turned on, at 7.30 o'clock, A. M.

TABLE II.—TEMPERATURE OF ENTERING AIR DURING TEST, DEG. F.

Readings.	1	2	3	4	5	6	7	8	9	10	11	12
Room No. 3	74	70	72	73	70½	73	70	71	73	70	73	69
Room No. 8	68	76	109	76	98	72	80	94	68	97	65	83

A simple device for humidifying is located between the tempering stacks and the fan inlet, and is controlled by a humidistat, which is in a part of the

From the accompanying Table III, giving the data compiled from these observations, it will be seen there was a margin of 35 min. in favor of Room 3.



PLAN OF THE ATTIC OF THE ROCKFORD SCHOOLHOUSE.

TABLE III.—RECORD OF OBSERVATIONS ON HEATING ROOMS TO 68° F.

	Initial Temperature, Deg. F.	Rise, Deg. F.	Time.	Time Required.
Room No. 3	38	30	8.50 a. m.	1 hr. 20 min.
Room No. 8	42	26	9.25 a. m.	1 hr. 55 min.

No difficulty was encountered in operating room No. 3 with the same apparatus while meeting the requirements of the remainder of the building. With the encouraging results obtained the Hall School was equipped throughout, during the summer of 1912, with the new method, and has been in operation since September 1, 1912.

HALL SCHOOL INSTALLATION.

The Hall School building is of brick, with wood floor construction, two stories in height, with full basement. It contains five regular school rooms on each of the two floors, with wardrobes, recitation rooms, principal's office, and corridors. The contents above the basement comprise 124,500 cu. ft. The building has a pitched roof with asbestos slate covering. One room in the basement is used for the mechanical equipment. The power-house is isolated and constructed mostly below grade. It communicates with the mechanical equipment room in the basement by a concrete tunnel 4 ft. wide, 6 ft. 6 in. in height, and 17 ft. long.

The mechanical equipment comprises a multivane No. 13 fan, direct connected to a side crank engine, and operates at 174 R. P. M. All radiation and Vento blast coils are operated on the Webster system of vacuum heating. Johnson Service temperature regulation with intermediate control is used in each room. All galvanized ducts from the plenum chamber are of regulation design, with the exception of having been run to points where it was possible to take air delivery into the rooms from the front end of same.

Each of the ten school rooms is equipped as follows: A coil consisting of about three 1¼-in. pipes extends entirely around the room approximately 5 ft. from the exposed walls and 6 ft. from the inside walls. These pipes are suspended by special hangers 20 in. below the ceiling, as shown in an accompanying illustration. These coils are supplied individually by a 1¼-in. riser from the main in the basement. The riser is equipped with a modulation valve about 34 in. above the floor, which gives it a slight offset. A single return takes care of the two coils in series from the first and second floors, respectively.

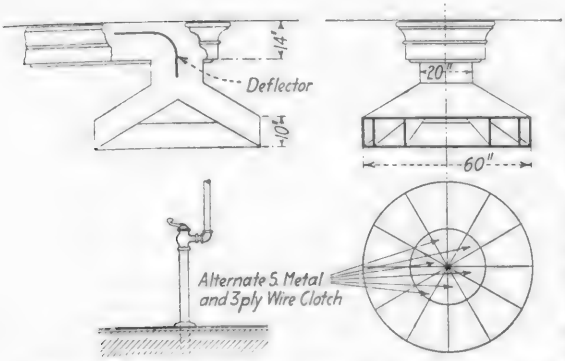
A galvanized-iron duct, 14x28 in., extends from the connection with the flues from the basement to a point central over the seating section of the room, from which the air is delivered to the room through an especially constructed diffuser, which breaks the velocity and directs the fresh air out in all directions over the breathing zone. This diffuser is located at a height to admit the air for ventilation to the room just below the stratum of the air at the ceiling, which is holding a uniform density by contact with the direct radiation.

The foul-air exits on the first floor are at the floor line in the four corners of the room, and are faced with sheet metal frames and louvers, as shown in an accompanying illustration. The air discharges through these into vertical galvanized pipes, 12 in. in diameter, which extend upward through the second floor.

The foul-air exits on the second floor are located the same as on the lower floor, and connect with the foul-air, 12-in. round pipes from below, increased to 17 in. in diameter. These vent pipes lead to the attic, where they are gathered in groups, and discharge to the outer atmosphere. The sizes of these vent pipes were simply increased by multiples of the cross sectional area, the increase of resistance being relied on in the use of this method to maintain a sufficient static pressure in the rooms. All galvanized vent pipes below the attic are lathed and plastered on the outside. Only the exit frames are visible.

The principles on which this new method of heating and ventilating operates are as follows:

The direct radiation at the ceiling is the real vanguard of the heating agent



DETAILS OF AIR DIFFUSER AND VALVE CONNECTION TO CEILING COIL.

for the room. The greater percentage of heat loss is prevented by close contact with the part of the room which is most difficult to control, and is kept down to the minimum of difference in temperature between the floor and the ceiling. A warm-air stratum at the ceiling remains uniform in temperature and ceiling, and is always of slightly lower temperature than the air at the ceiling. This leaves a narrow range for variation in temperature of ventilating air to complete further the fine art of temperature control.

The air for ventilation is directed over the floor area of the room and is increasing in density at the moment of discharge, with the result that it falls to the floor as the forces of mechanical energy are exhausted. On arriving at the breathing zone, gravity plus static pressure forces the air out of the room at the floor line, producing a movement of air downward at a velocity of approximately 2 ft. per minute, with positive absence of lateral drafts or air currents. This condition is not disturbed until below the top of the exits, and even then there is no noticeable air movement over the floor, due to the comparatively small exits drawing on a

VIEW IN ONE OF THE ROOMS EQUIPPED WITH DIFFUSERS.

density. This influences the temperature of the room below without the air descending to the floor. The air for ventilation is previously warmed by Vento stacks in the basement, and enters the room through the diffuser, just below the warmer stratum of air at the large volume. Each vent screen contains 1.1 sq. ft. clear area, which equals 4.4 sq. ft. for each room.

The accompanying Table IV gives the velocity and delivery records of all exits for ten 1-min. readings taken after the system has been put in operation.

TABLE IV.—RECORDS OF AIR VELOCITIES AND DELIVERIES AT VARIOUS EXITS.

Room Number.	Cubic Feet Per Minute. Northwest Exit.	Northeast Exit.	Southeast Exit.	Southwest Exit.	Total. Delivery.
1	270	384	326	400	1,518
2	390	394	396	350	1,683
3	390	400	450	314	1,709
4	332	354	460	446	1,751
5	364	360	334	332	1,529
6	336	346	345	342	1,506
7	352	406	334	350	1,586
8	434	428	448	366	1,843
9	344	328	356	384	1,553
10	412	336	370	282	1,590

The following is a summary of observations made while this system has been in operation:

A temperature of 85° F. at the ceiling has been found to be sufficient as a maximum.

The temperature is controlled within a range of 1° F., in all parts of the room throughout the breathing zone.

Air never enters the room above 73 to 74° F.

All rooms show an absolute sense of proportion and freshness.

There is no noticeable effect on the conditions of the rooms caused by the glass exposure, but tests show a slightly higher rapidity in downward movement of the air surface several inches in from the glass.

The air distribution is positive and under normal school-room conditions, the aerial envelope around any individual is moving downward and does not come in contact with that of another but is discharged from the room without rising again to the breathing zone.

There is an entire absence of drafts or currents, and the cold surface of desks and furniture does not contrast against high temperatures of atmosphere surrounding them, as is often complained of in other systems.

During the week of December 15 tests were conducted by the school authorities to determine the efficiency of this system. The temperature was uniformly 68°, and the humidity at 58%. To demonstrate that no cross currents existed, live steam was introduced into the room through the diffuser in the ventilating system. The steam distributed equally throughout the room and dropped gradually toward the floor, like a blanket, until it reached the level of the exits through which it escaped. Another test comprised the suspending of a large number of strings about the room with small pieces of paper attached to the end of each. The absence of any swaying of these pieces of paper showed that there were no cross currents generated by the ventilating system.

Some observations have been made of the amount of leakage. Readings of static pressures were taken with Ellison's differential draft gauge, which, being balanced at zero outside of the building, showed 0.03 in. pressure when connected with the inside of the room. All windows are provided with grooved weather strips, and are more than ordinarily tight, yet all these tests where steam was turned into the room showed a decided leakage outward, particularly

VIEW OF ROOM VENT OPENING.

between the meeting rails of the sash, which were purposely pried slightly open to allow a chance to observe if leakage was inward or outward.

Economy of operation is evident, but as yet no effort has been made to determine any facts of comparative saving. The studies of this method are incomplete at this time, owing to not having the time or opportunity to continue an uninterrupted study.

The consensus of opinion with the members of the Board of Education is that the installation at Hall School is a decided success. Teachers are enthusiastic. Pupils show no signs of restlessness toward the close of the school day. The school principal claims a noticeable improvement in the work done by both teachers and pupils.

VIEW DURING STEAM TEST, SHOWING UNIFORM DOWNWARD DISTRIBUTION.

ARRANGEMENT FOR FLUSHING ROOM.

It may be of interest to submit the theoretical continuation of the method, if it be demonstrated in operation that it were desirable to put the same into practice. That is to arrange to thoroughly flush rooms and thereby discharge to the outside atmosphere any gases of harmful nature that might raise up out of air at breathing zone, and enrich the stratum of air at the ceiling to a point where the same would have any undesirable influence on the room.

A brief description of the means to this end, as contemplated in my theory is as follows:

A second air exit is provided in each corner of the room at the ceiling line, directly over exit at floor. Exit at floor and ceiling thus communicate to galvanized iron pipe discharging to out door atmosphere. Exits at top and bottom are provided with pivoted louvres with shutter bars, which are cross-con nected between shutter bar of top and bottom sets. A small diaphram motor, operating on air pressure from temperature control system keeps lower exit open and top exit closed when rooms are occupied and ventilation with air distribution is desired. By operating a simple three way cock on air line in apparatus room, the bottom exit is closed and the top exit is opened which clears the room of air at ceiling thereby thoroughly flushing out the room and giving an entire new air content.

The writer holds to the belief that the impure gases resulting from expired air are for the most part passed out of room with outgoing air, with the system as installed in Hall School. However, be-

fore the close of the heating season systematic observations will be made by fitting one room with the complete arrangement, as contemplated in my theory and described herewith, permitting comparative observation between the rooms not arranged for daily flushing and the room so arranged.

*The Design of Indirect Heating Systems With Respect to Maximum Economy and Operation**

CURVES SHOWING THE RELATIONSHIP OF SURFACE, VELOCITY AND POWER COST DUE TO THE RESISTANCE.

By FRANK L. BUSEY and WILLIS H. CARRIER.

Loss of pressure due to frictional resistance to the passage of air used for heating and ventilating purposes through heaters and piping or conduits has received considerable attention on the part of many of those directly interested in this phase of engineering.

It will be the object of this paper to show that there is a definite relation between the cost of power and the cost of the apparatus, and to determine what ratio between these two factors will insure the lowest practical yearly outlay to cover the cost of power, as well as an allowance on the cost of the installation to care for interest and depreciation. It may be shown that, according to present practice, the velocities used are entirely too high for economical results.

Although at the present time we have reliable data as to the rate of heat transmission under various conditions and also on the frictional resistance of heaters at different velocities, we have no rational basis for determining what velocities should be used from the standpoint of operating economy.

At present the practice is to assume fan pressures arbitrarily, at, say, ½, ¾ or 1 oz., and proportion the apparatus accordingly, so that the total pressure will not exceed the operating pressure at the fan. This is a good engineering basis for obtaining results, without respect to operating economy.

FRICTIONAL RESISTANCE OF HEATERS AS A BASIS FOR FIGURING EFFICIENCY.

The frictional resistance of various pipe heaters will not vary greatly, except as may be due to difference in the spacing. Based on experimental data the most efficient spacing of staggered pipes seems to be where the distance between two consecutive pipes in a row is exactly equal to the diameter of the pipe, as shown by the accompanying sketch.

In general the law seems to hold that the rate of heat transmission varies with the frictional resistance of the heater. The relative efficiency of two heaters should be based on the rate of heat transmission under identical temperature conditions and with *equal pressure losses* in forcing the air through the heater, and not upon the so-called velocity through the clear area, which is more or less of a hypothetical quantity.

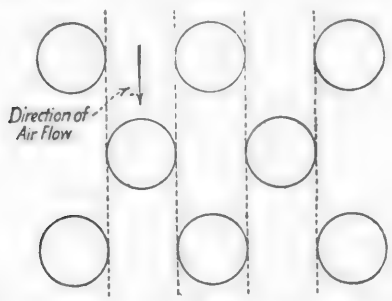
Any decrease in the velocity of the air through the heater means an increase in clear area with a decreased rate of transmission and a consequent increase in total surface required. It also reduces the friction and therefore the horse-power required at the fan, with an increase in the size of the fan and a decrease in the size of the motor. To get the same heating effect the depth of the heater must be inversely proportioned to the square root of the total surface, or directly, as the square root of the rate of transmission is determined by the velocity. The horsepower and the pressure loss vary directly as the seven-thirds power of the velocity when the heater is proportioned to give the same temperature rise to the same quantity of air. (The formulas expressing these relationships, together with their derivation, were included in the complete paper.)

It might be well to suggest in this connection that increasing the surface of the heater by the use of the additional

*From a paper read before the American Society of Heating and Ventilating Engineers, Jan. 21-23, 1913.

sections will not answer the purpose intended, as this would increase the pressure and power required. The increase in surface must be obtained by using larger sections with the greater clear area, so as to handle the same amount of air at the reduced velocity, using the same temperature rise.

The method already mentioned of assuming a total pressure against which the fan is to operate and then so proportion the various pressure losses as to



SPACING OF PIPES IN FAN HEATER.

keep within this limit fails to take into consideration the element of power cost at the fan. That this is an item of more than secondary importance will be shown, together with the relation of the cost of installation to the subsequent cost of power. These are two items of cost to be considered, and the relation between them will be shown for various conditions.

VELOCITY FOR MAXIMUM ECONOMY.

Assuming a static efficiency of 40% for the fan—that is, 40% of the brake horsepower consumed by the fan is usually employed in moving the air against static resistance—the horsepower required due to any resistance or pressure drop through the heater will be the product of the air handled times the pressure drop expressed in inches of water times a constant, 0.000405. Expressed as a formula this becomes

$$H = 0.000405\ p\ Q$$

The yearly cost for the power consumed in overcoming the resistance will be the product of this horsepower times the yearly cost per horsepower. The yearly allowance on the cost of the installation for the interest and depreciation may be varied according to circumstances, the probable limits being 15% to 25% yearly for any ordinary installation. As will be shown, these relations may be expressed by a series of formulas and any specified case analyzed.

Letting C_p represent the total year cost of power at the fan, and m the cost per horsepower year, we will have

$$C_p = 0.000405\ m\ p\ Q = m\ H$$

Also letting C_s represent the yearly charge for interest and depreciation, based on the cost of the heater, and S the total square feet of surface in the heater, we will have $C_s = s$, times the allowance per square foot for interest and depreciation.

Letting C_{po} and C_{so} be the respective costs at any assumed velocity, V_o, through the clear area, and C_p and C_s be the corresponding costs at any other velocity, V, we have

$$C_s = C_{so}\left(\frac{V}{V_o}\right)^{2}$$

and

$$C_p = C_{po}\left(\frac{V}{V_o}\right)^{3}$$

(Proofs of these relationships were included in the complete paper.)

We also have

$$\left(\frac{V_m}{V_o}\right)^3 = 0.286\ \left(\frac{C_{so}}{C_{po}}\right)$$

and

$$V_m = 0.66\ V_o\left(\frac{C_{so}}{C_{po}}\right)^{\frac{1}{3}}$$

If the assumed velocity V is also the most economical velocity, then $V_o = V_m$ and

$$\left(\frac{V_m}{V_o}\right)^3 = 1$$

Assuming then, that the chosen velocity is that which gives maximum economy, we have

$$0.286\left(\frac{C_s}{C_p}\right) = 1$$

or

$$C_p = 0.286\ C_s$$

This means that for the most economical installation the yearly cost of the power consumed in overcoming the

friction of the heater should be 28.6% of the annual cost of the heater; that is, annual interest and depreciation allowance based on initial costs.

We may also see that the velocity through the clear area for the maximum economy is independent of the depth required, temperature rise, or the steam pressure. That is, if we increase the depth of the heater to give the greatest temperature rise it is evident that the cost of power and the cost of the heater are each increased in exactly the same

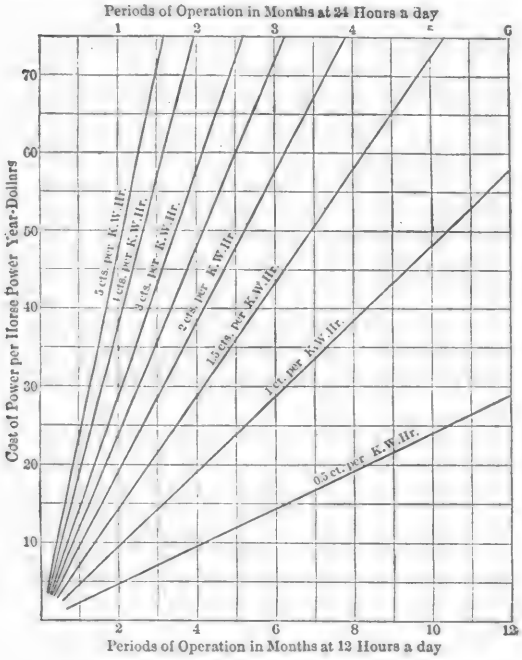


FIG. 1.—COST OF POWER PER HORSE POWER PER YEAR AT VARIOUS PRICES FOR POWER AND PERIODS OF OPERATION.

proportion, since they both increase exactly in proportion to the increase in the depth of the heater. Hence the value of V_m remains unchanged.

PRACTICAL APPLICATION.

These relationships of surface, velocity and power cost, due to the resistance, may best be shown by means of a specific example, to which the accompanying curves apply. Any other assumed conditions may be treated in the same manner.

As frequent reference will be made to the cost of power per *horsepower year* at the fan, due to forcing the air through the heater against the frictional resistance, Fig. 1 is given to show the relation between this unit and the common one of cost per kilowatt hour. Across the lower edge of the diagram are laid out the periods of operation in months of twelve hours a day, and across the top months of twenty-four hours a day. Any combination of operating periods may be found on these scales. The diagonal lines represent the cost of power in cents per kilowatt hour and the left edge the corresponding cost per horsepower year.

Thus, a plant operating four months a year and twelve hours a day, with power costing 2.5 cents per KW.-hr., will be paying $47.50 a year per horsepower. If power costs 1 cent per KW.-hr., the horsepower will cost $20 a year. As already shown, the cost per year due to the frictional resistance of the heater will be

$$C_p = (0.000405\ p\ Q)\ m = H \times m$$

where m is the cost per HP. yr.

Take, for example, a case where 30,000 cu. ft. per minute is to be warmed from 0° to 103° F., by means of a Buffalo pipe coil heater. Assuming for convenience a velocity of 1,000 ft. per min., through the clear area, we will require a heater five sections or 20 rows of pipe deep, with 184.3 sq. ft. of surface per section. The loss of pressure due to the frictional resistance will be 0.48 in. Then

$$Q_o = 30000$$
$$V_o = 1000$$
$$S_o = 184.3 \times 5 = 921.5\ (\text{sq. ft.})$$
$$p = 0.48\ (\text{in.})$$

Operating four months a year at 12 hrs. a day, with power costing 2 cents per KW. hr., the yearly cost of power will be $40 per horsepower. Then the horse-power required will be

$$H = 3000 \times 0.000405 \times 0.48 = 5.83$$

and

$$C_{po} = 5.83 \times \$40 = \$233 \text{ a year}$$

Allowing 15% on the cost of the installed heater for interest and depreciation on a cost of 35 cents per square foot, we will have

$$C_{so} = 921.5 \times \$0.0525 = \$48.4 \text{ a year}$$

Then the maximum economical velocity for these conditions will be

$$V_m = V_o \times 0.66 \left(\frac{C_{so}}{C_{po}}\right)^{\frac{1}{8}}$$

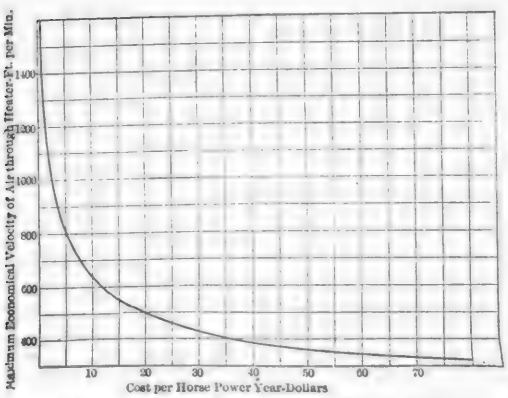


FIG. 2.—MAXIMUM ECONOMICAL VELOCITY FOR DIFFERENT COSTS OF POWER, ALLOWING 15% ON COST OF HEATER FOR INTEREST AND DEPRECIATION.

$= 1000 \times 0.66 \times 5925 = 391$ ft. per min.

Substituting the various costs per HP. yr., in the above formula, we may determine the corresponding maximum economical velocity for each case, and these values plotted, as in Fig. 2. From this curve may be determined V_m for any intermediate power cost.

From Fig. 2 it may be seen that, if a return of 15% is desired on the investment, in order to use a velocity of 1,000 ft. per min., the power should not cost more than $2.50 per HP. yr. This would only be the case where the fan was driven by a steam engine, and the exhaust steam used in the heating coils, practically using the engine for a reducing valve.

Fig. 3 shows the same relation of power cost to velocity when 25% is allowed for interest and depreciation. The curve is similar to that in Fig. 2, but shows the greater velocity allowable under this condition.

The curves in Figs. 4 and 5 show the general relation between the cost of the power due to the frictional resistance through the heater at the two rates of $10 and $40 per HP. yr., the interest and depreciation allowance on the cost of the heater and the sum of these two, or the total yearly charge. For Fig. 4 an allowance of 15% is made for interest and depreciation, while for Fig. 5 this allowance is 25%. The cost of power is the same for each set of curves, but the combined curve $(C_s + C_p)$ is different, due to the difference in the value of C_s. The curve $C_s + C_p$ represents the combined cost per 1,000 cu. ft. of air per min., due to the interest and power cost for the different velocities. From Fig. 4 we see that if power costs $40 per HP. yr., the lowest total cost of operation will be $3.75 per 1,000 cu. ft. per minute, at a velocity of 400 ft. per min., through the heater. It may be easily noted from the curve how the increase in velocity makes an increase in cost. The velocity at the low points on these total cost curves should correspond to the velocity from the curve in Figs. 2 and 3 for the same cost per HP. yr. The two values of $10 and $40 per HP. yr. are taken merely as two representative costs, and the curves may be plotted for any other horsepower cost or interest allowance.

PRESSURE LOSSES IN PIPING SYSTEM.

The losses in the piping system are made up of two parts, the dynamic losses and the friction losses. The dynamic losses are due to changes, either in the direction or velocity of the air flow, and are composed of the loss of entrance and of the loss in elbows and connections. The first is the pressure required to produce velocity itself in the pipe, and may vary anywhere from 1 to 1.5 times the velocity head *i. e.,* the pressure corresponding to the av-

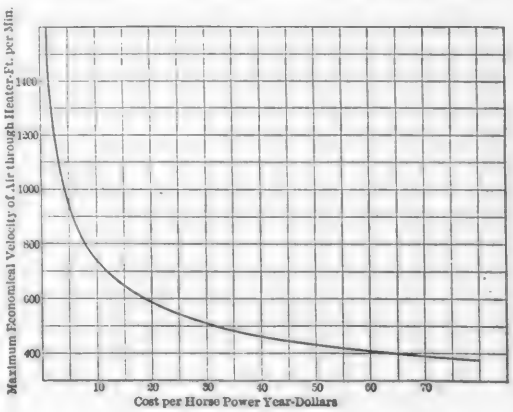


FIG. 3.—MAXIMUM ECONOMICAL VELOCITY FOR DIFFERENT COSTS OF POWER, ALLOWING 25% ON COST OF HEATER FOR INTEREST AND DEPRECIATION.

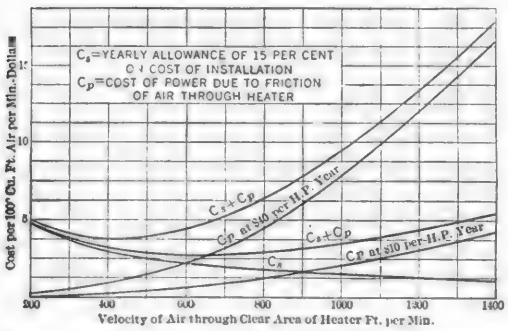

C_s=YEARLY ALLOWANCE OF 15 PER CENT ON COST OF INSTALLATION
C_p=COST OF POWER DUE TO FRICTION OF AIR THROUGH HEATER
Cost per 1000 Cu. Ft. Air per Min.-Dollars
C_s+C_p
C_p at $40 per H.P. Year
C_s+C_p
C_p at $10 per H.P. Year
C_s
200 400 600 800 1000 1200 1400
Velocity of Air through Clear Area of Heater Ft. per Min.

FIG. 4.—RELATIVE YEARLY INTEREST AND DEPRECIATION COST OF SURFACE AND POWER COST DUE TO FRICTION OF AIR THROUGH HEATER AT VARIOUS VELOCITIES THROUGH THE CLEAR AREA, ALLOWING 15 PER CENT. ON COST OF HEATER FOR INTEREST AND DEPRECIATION.

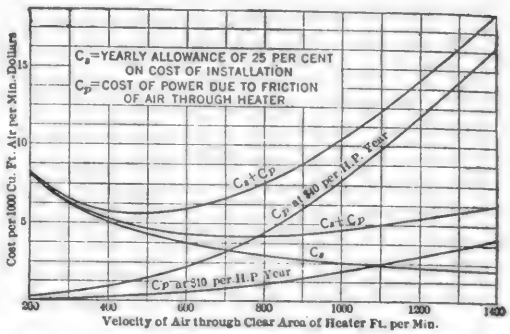

C_s=YEARLY ALLOWANCE OF 25 PER CENT ON COST OF INSTALLATION
C_p=COST OF POWER DUE TO FRICTION OF AIR THROUGH HEATER
Cost per 1000 Cu. Ft. Air per Min.-Dollars
C_s+C_p
C_p at $40 per H.P. Year
C_s+C_p
C_s
C_p at $10 per H.P. Year
200 400 600 800 1000 1200 1400
Velocity of Air through Clear Area of Heater Ft. per Min.

FIG. 5.—RELATIVE YEARLY INTEREST AND DEPRECIATION COST OF SURFACE AND POWER COST DUE TO FRICTION OF AIR THROUGH HEATER AT VARIOUS VELOCITIES THROUGH THE CLEAR AREA, ALLOWING 25 PER CENT. ON COST OF HEATER FOR INTEREST AND DEPRECIATION.

erage velocity produced in the pipe. Where the velocity in the pipe is the same as at the fan outlet this may still be considered a loss, in view of the fact that with a reduction of velocity through a gradually diverging outlet to a larger area the difference between the velocity head at the fan and the velocity head in the pipe is largely utilized by conversion to static pressure.

The other chief source of dynamic loss is in the elbows, and depends on the radius of curvature of the elbow and not on the size of the elbow or the velocity of the air. This loss may be expressed directly in per cent. of the velocity-head, and, with a round, five-piece elbow, having a center line radius of one diameter, the loss will be 25% of the average velocity-head. With a five-piece elbow having a center line radius of one and one-half diameters the loss will be 17%, or only two-thirds that of the first case. This shows the advantage of an intelligently-designed system and the possibility in power saving, for the elbows may be of so short a radius as to cause the loss of an entire velocity-head in each elbow.

The second source of pressure loss in the piping system is due to the friction of the air against the sides of the pipe. This loss will vary directly as the length of the pipe, or as the square of the velocity, and inversely as the diameter of the pipe. As the length is a fixed quantity for any system, the only factors subject to modification are the diameter and velocity, which determine the relation between the power cost and the piping cost.

As in the case of the heaters, it is the usual engineering practice to proportion the piping arbitrarily, either from assumed velocities depending upon the velocity of the air at the fan outlet, or, in better engineering practice, by determining the velocity which will give an assumed resistance considered suitable and within the fan capacity. It is the usual practice among fan manufacturers gradually to decrease the velocity of the air in the main conduit, as the latter is decreased in size, owing to partial delivery of the air through the branch outlets.

This practice serves three useful purposes:

1. A proper proportioning of the velocities permits a uniform delivery of the air through all of the branch outlets without dampers and regardless of the distance from the fan.

2. By a gradual reduction in velocity a considerable proportion of the velocity pressure is usefully converted to static pressure, thus largely compensating for the piping friction.

3. It decreases the friction in the smaller piping, where it would otherwise be the greatest.

The sizes of the branches or reduced piping may be proportioned directly from the assumed size of the main pipe without calculation by referring to the accompanying chart, Fig. 6 (published

in a treatise on "Heating and Ventilation," issued by the Buffalo Forge Co. in 1908).

For example, assume we have a branch intended to carry 50% of the capacity of the main pipe, which is 50 in. in diameter. Starting at the bottom of the chart with 50% capacity, we pass upward until we intersect the line A, thence horizontally until we strike the diagonal line marked 50, thence upward to the scale at the top of the chart,

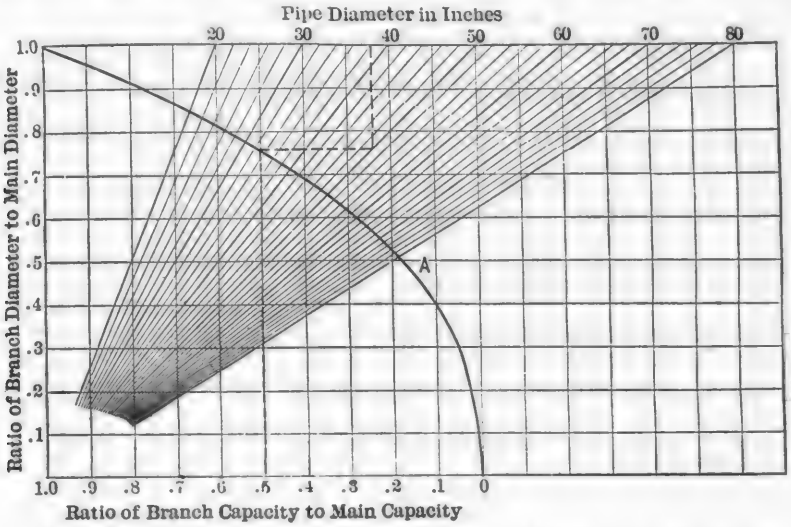


FIG. 6.—PROPORTIONING PIPING TO ALLOW FOR FRICTION.

which gives us a diameter of 38 in. for the branch pipe. This then is so proportioned as to give us the same friction per foot of length as in the main pipe. This permits the resistance of the entire system to be calculated as though it was of one diameter, with a corresponding velocity throughout its entire length.

VELOCITY FOR MAXIMUM ECONOMY.

A decrease in velocity increases the size and cost of the air conduit, but decreases the cost of power consumed in overcoming the conduit or piping resistance. From a point of economy the question to be determined is what relation between power cost and conduit cost, as determined by the velocity, will give the minimum annual total cost. This relationship is shown to be

$$\left(\frac{V_m}{V_o}\right)^3 = .0335\left(\frac{C_{wo}}{C_{po}}\right)$$

or

$$V_m = 0.7\, V_o\left(\frac{C_{wo}}{C_{po}}\right)^{\frac{1}{3}}$$

Where C_{po} and C_{wo} represent respectively the cost of power to overcome piping resistance and the annual allowance on the cost of the piping for interest and depreciation at an assumed velocity V_o, and V_m is the relative velocity required for maximum economy.

Comparing these relationships with those obtained for the heater, it is evident that they are almost identical. It will be seen in this case that for the maximum economy the annual cost of power consumed by piping resistance should be practically one-third of the annual interest and depreciation charges, based on the initial cost of piping. That is, $C_p = 0.335\ C_w$ for maximum economy.

PRACTICAL APPLICATIONS.

For the purpose of illustrating the application of the foregoing principles to a system of galvanized iron piping different cases will be assumed and the results shown. A system handling 30,000 cu. ft. per min., at a velocity of 1,950 ft. per min., will require a pipe 53 in. in diameter, or an area of 15.32 sq. ft. These quantities will be taken as a constant condition, but different arrangements considered in the system of piping.

Assuming one straight duct 200 ft.

long and 53 in. in diameter, delivering all of the air at the end farthest from the fan, we will have two sources of loss to be overcome by the fan. First, the dynamic loss due to the velocity of 1,950 ft. per min. (or one velocity-head), and second, the loss due to friction, amounting to one velocity-head in each forty diameters of length. The pressure due to the velocity of 1,950 ft. per min. in the pipe (one velocity-head) will be 0.237 in., water gauge. The loss of pressure due to friction will be

$$\frac{200}{4.42 \times 40} = 1.13 \text{ velocity head.}$$

This loss expressed in inches of water will be

$$0.237 \times 1.13 = 0.257 \text{ in.}$$

and the total loss will be the sum of these two, or 0.494 in. In the piping system a part of the velocity is converted to static pressure, hence the power calculation should be based on total pressures with a corresponding fan efficiency of 50%. At a rate of $20 per HP. yr., the annual cost due to the piping resistance will be

$$C_{po} = 30{,}000 \times 0.000324 \times 0.494 \times 20 = \$96.$$

A round galvanized iron pipe, 53 in. in diameter, would be made of No. 18 iron, weighing 2.3 lbs. per sq. ft., and would contain 14.2 sq. ft. per running foot. This would make 32.7 lbs. per running foot, or a total of 6,540 lbs. for the entire pipe. Allowing 25% annually for interest and depreciation on an initial cost of say, 10 cents per pound, the yearly allowance would be 2.5 cents per pound of iron. Then we would have as the yearly allowance for interest and depreciation

$$C_{wo} = 6540 \times \$.025 = \$163.50$$

From the last equation we may determine that for the most economical conditions the velocity of the air in the pipe should be

$$V_m = 0.7 \times 1950 \left(\frac{163.5}{98.0}\right)^{\frac{1}{3}} = 1620 \text{ ft. per min.}$$

Assuming the case where the 30,000 cu. ft. per min. is to be uniformly distributed by a galvanized iron pipe 200 ft. long, with equal openings every 20 ft. of its length, each discharging 3,000 cu. ft. per min., we will have an example of another common form of installation. Referring to the chart, Fig. 6, we see that, if the first 20 ft. of pipe is 53 in. in diameter, the next 20 ft. carrying 90% of the air should be 51 in. in diameter. Treating each successive section in the same manner we may determine the diameter and weight of each section, and will find the total weight of the piping to be 3,922 lbs. Then the yearly total allowance for interest and depreciation on the piping system will be

$$C_{wo} = 3922 \times .025 = \$98.05$$

The loss in pressure due to friction will be the same as in the first case considered, or 0.257 in., but the loss due to the velocity will be only about 40% of the loss, as calculated in the first example, or 0.095 in. The total pressure loss will then be

$$0.257 + 0.095 = 0.352 \text{ in.}$$

and the annual power cost at $20 per HP. yr. will be

$$C_{po} = 30{,}000 \times 0.000324 \times 0.352 \times 20 = \$68.50$$

As before, from the same equation we will have as the velocity for the most economical operation

$$V_m = 0.7 \times 1950 \left(\frac{98.05}{68.50}\right)^{\frac{1}{3}} = 1540 \text{ ft. per min.}$$

Another example of the application of the relationship herein presented would be to assume a case of an entire installation of fan, heater and piping. As already suggested, a probably fair average annual allowance on the entire apparatus for interest and depreciation would be 20% on the first cost of the installation. Assuming that, in order to obtain the most economical operation the yearly cost of power should be 30% of the above 20% allowance, we have the yearly power cost as equal to 6% on the initial cost of the installation. Allowing $20 per H. P. yr. as the cost of power, we will find from Fig. 3 that, with a 25% allowance in the cost of the heater for interest and depreciation, the velocity through the heater should be approximately 590 ft. per min. in order to operate at the point of greatest economy.

For the same assumed conditions as to air handled, the resistance through

the heater will now be 0.145 in. and at the most economical velocity through the piping system the pressure loss will be 0.31 in., making a total pressure at the fan of

$0.145 + 0.31 = 0.455$ in., or 0.254 oz.

The total annual cost of power will then be

$$C_p = \$98$$

instead of $212.50 under the first assumed conditions when using one straight run of pipe 200 ft. long. This would show a saving of $114.50. The total cost of the apparatus as at first assumed would be approximately $1,331, so that the power cost of $212.50 would amount to 16% on the initial cost of the apparatus.

The total cost of the apparatus, as revised to meet the more economical conditions, would be $1,660, or an increase of $329. The yearly cost of power would be 5.9% on the initial cost, and we would have an allowance of 19.7% for interest and depreciation on the entire installation. The saving of $114.50 would make a return of 35% on the additional investment.

CONCLUSION.

Based on the foregoing deductions it is evidently not only possible but practical to lay out a heating and ventilating system in such a manner as to obtain any desired economic results with as much certainty as is at present done with regard to the strictly engineering features.

As regards the heater, the most economical point will be reached when the installation is so proportioned that the yearly cost of power due to the frictional resistance of the heater amounts to 28.6% of the annual interest and depreciation allowance on the first cost of the heater. This is true regardless of variations in the depth of heater, temperature rise or steam pressure.

The most economical velocity through the piping or conduits is such that the annual cost of power due to the piping resistance is one-third of the annual allowance for interest and depreciation. This latter may be assumed to be about 25% on the original cost of installation.

While these lower velocities and consequently lower resistance would require the use of larger fans in order to operate at high efficiency, considering the entire installation of heater, piping and fan, the annual cost of power should be practically 30% of the total annual allowance for interest and depreciation. If this allowance is taken at 20% as an average, we would have 6% on the first cost as the most economical yearly rate to be allowed for power.

Heating and Ventilating Congress at Cologne.

Announcement has been made that the forthcoming Congress of Heating and Ventilating Engineers will be held this year at Cologne, Germany. The chairman of the organization committee is Konrad Hartmann, of Berlin. The congress will be held the last of June and will continue three days.

Profit Sharing for Architects and Engineers

Profit sharing by employers with their employees in the architectural and engineering line received a practical endorsement at a banquet held at the Hotel Walton, Philadelphia, February 17, at which were gathered 32 associates and employees of New York and Philadelphia offices of Ballinger & Perrot. The plan, which was announced by Walter F. Ballinger, senior member of the firm, is on a two-fold basis. The first consists of a division of a certain sum set aside from the profits in which all the employees will share equally, irrespective of their salaries. The second division is that of an additional amount based upon the proportion which each employee's salary bears to the total amount of salaries paid. Emile G. Perrot then distributed checks to the company's several employees representing their proportion of the profits of the past year on the basis outlined. The company reported the most prosperous year in its history. During the past year Ballinger & Perrot have been engaged in the designing and construction of more than forty institutions and industrial plants throughout the country ranging in value from $3,000 to $600,000, including a model workingmen's village of over 250 houses, which is now being built near Chester, Pa.

The distribution of profits at the dinner was entirely at the initiative of the firm and as it had not been previously announced by them the surprise and pleasure of the recipients was doubly marked.

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THE adoption of a resolution by the civil engineers' society authorizing the appointment of a committee to consider improvements in the presentation of papers at its professional sessions, brings up a matter of interest to all engineering societies. The action arose from a comment that the meetings are often listless and uninteresting. As one speaker said, for instance, unless the author of a paper is present to address the meeting in person, the reading of his paper is likely to be a dull procedure. The presentation of a highly technical paper is also apt to be rather tedious and a suggestion made regarding such papers was that they should be placed in a class by themselves and not presented in detail at the meeting, although, of course, included in the printed transactions.

This matter comes with particular force to heating and ventilating engineers at this time because organizations for furthering technical knowledge are on the increase and it is exceptional to find an engineer who is not a member of one or more technical bodies. Moreover, heating engineers have been treated within the past year or two to some excellent examples of the impressive manner in which a technical subject may be presented. One of these, an address on the subject of the carbon dioxide air test, may be said to have fairly jolted the profession, while, more recently, an address on the use of ozone in connection with ventilating work was, in many ways, a model for lucidity and interest.

One of the suggestions made for improving the proceedings is that papers be presented in abstract, rather than in full. The danger here lies in overshooting the mark and discouraging that elaborate preparation which a subject frequently requires. There is a well-defined sentiment against departing in any essential particular from the present practice in this respect, but this would not preclude the presentation of technical papers in the conversational, rather than written, language of the author. In short, the proposal is that authors present their subjects by telling their hearers what they have written rather than by reading it word for word, or by abstract.

ANNOUNCEMENT is made that the "New York Factory Bills," comprising thirty-two measures recommended by the New York Factory Investigating Commission have been duly presented to the State legislature. In connection with the proposed department of industrial hygiene, one of the functions of this board, it will be recalled, is to establish ventilation standards for the industries, such standards to vary as required with each industry. It is also notable that provision is made on the proposed board for technical representation.

THE CONSULTING ENGINEER

"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

13.—Designs of Vacuum Heating Systems.

QUESTION: What is the best way to design heating plants, especially for deciding the size of the vacuum pump for vacuum systems?

(a) The ratio of the size of the vacuum pump and total radiating surface of all radiators used on direct heating.

(b) Ratio of the size of the vacuum pump to the grate area of the boiler.

(c) Ratio of the size of the vacuum pump and heating surface of the boiler.

Suppose we make a comparison of a plant operating from 10 lbs. pressure to zero pressure and one designed to operate from 2 lbs. pressure to 10 in. of vacuum. In the first case, there is always pressure to remove air and all leaks are outward instead of inward, as compared with the latter case, where the system has to be absolutely air tight or mechanical means provided to remove the air. The relation of the pressures and volumes will be as follows:

The range in temperature is exactly the same, 28°; the amount of extra surface required is exactly 11% more for the system operated at the lower temperature.

Pressure		Temperature Deg. F.		Range Deg. F.	Volume Cu. Ft. Per Pound		Relative Size Mains	Temp. Heating Surface —70°F.	Relative Per Cent. Heating Surface
Max.	Min.	Max.	Min.		Final	Initial		Deg. F.	
10 lbs.	0 lbs.	240	212	28	26.3	16.3	100	240-70	100
2 lbs.	10 in vac.	219	191	28	40.1	23.6	150	219-70	111

ANSWER: (a) (b) (c) are practically the same question asked in different form. The ratio of the size of the vacuum pump to total radiating surface, multiplied by the ratio of total radiating surface to grate and heating surface of the boiler, will answer (b) and (c).

The use of vacuum systems should be primarily applied to plants utilizing exhaust steam for heating and for the purpose of removing the air and water. Therefore, strictly speaking, the vacuum pump would have nothing to do with the heating surface or grate area of the boiler, as far as its size is concerned. The boilers might be 500 H. P. in capacity for power and only 100 H. P. required for the heating.

The economy of any heating system depends entirely upon the ease with which the temperature of the heating medium can be changed to suit outside temperature conditions and the limits of their range in temperature. Therefore, the nearer to atmosphere the steam is used, the less variation is possible in temperature and the more uneconomical it becomes. This applies solely to plants where the economy of engine operation is not involved, such as gravity return systems using boilers.

Due to the increase in the volumes of the steam caused by the lower pressures, the mains require 50% greater area for the same output and velocity. The economy of the two systems should be exactly the same if piping and operation are correct, while the radiation of the lower pressure system will require 10% increase, with 50% larger mains, increasing the cost accordingly. For the above reasons vacuum systems seem somewhat unnecessary where there is no exhaust steam and a gravity return of condensation to the boiler can be maintained.

When exhaust steam is utilized, the engine economy requires as low temperatures and pressures as possible and, as stated above, the boiler would have absolutely nothing to do with the size of the vacuum pumps. The only governing factor is the amount of air leakage which is entirely a question of careful construction and a matter of guesswork or actual test on each individual plant.

Steam at atmosphere is 1,700 times the bulk of water, so the bulk of water to be removed is comparatively small. The air to be removed

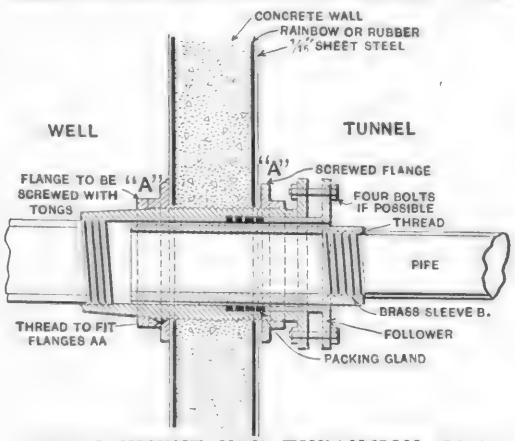
is in proportion to the leaks and cubic capacity of the plant, which latter can be easily estimated. As a rule, the leakage can be safely estimated on a fair job of piping at from 70 to 100% increase.

If the condensation is returned at 212° or atmosphere and 10 in. of vacuum is carried at the pump, a portion of this condensation will re-evaporate into steam at 10 in. vacuum and 191° temperature, causing the pump to race. This is overcome by using cold injection water, which is wasted if the exhaust steam is all utilized and all condensation returned.

The use of a piston pump for this purpose is not economical, although more commonly used than those of other types, as the steam consumption is about 120 lbs. per horse-power. The actual work is very little. A much more economical type of pump is the rotary, capable of handling air, water or steam. It requires one with small clearances, such as one built on the type of the Root blower, or as first-class hot well pumps are used in condenser work. The work done by the latter may be slightly more, but the cost per unit of power will be far less than the piston pump at 120 lbs. per horse-power.

14—Expansion Joint in Concrete Wall.

QUESTION: We have a sump tank of concrete, with several pipes running into it through a tunnel, under different temperature conditions. The pipes pass through the concrete wall below the surface of the water in the tank. They are rigidly fastened at the other end of the tunnel. How



ARRANGEMENT FOR EXPANSION JOINT IN CONCRETE WALL.

can expansion be provided for and the joint made water tight when passing through wall of tank?

ANSWER: The accompanying sketch shows how a common sleeve expansion joint may be adapted for this purpose. It should be of brass and the casting made so that a thread can be cut on the outside of the sleeve. This can be fastened rigidly in the wall and Flange A screwed up on a sheet of packing backed by a sheet of steel until a tight joint is made. The flange, A, should have little surface or the friction of turning will prevent it from making up tight. The stuffing box and sleeve will then be handled from the inside of the tunnel. The pipe connection may be flanged on one end, but will have to be screwed on the tank side.

It is always well to avoid these constructions when possible. One pipe is for a suction to a pump and if a foot valve were used and the pipe primed it might permit the water level to be lowered sufficiently to avoid a water-tight joint in the wall. The metal sheets packing next to the wall should be of some non-corrosive metal or kept painted. If not, the packing is likely to eat out.

Ventilation of Dining Cars.

An arrangement for ventilating dining cars in which an automatic and positive system is combined in one apparatus for use when the car is in motion and at rest, respectively, has lately been perfected and is shown in the accompanying illustration. it is known as the Garland combination blower and exhaust ventilator.

The original intention of the inventor, T. H. Garland, when designing the new ventilator was to overcome the difficulties which are experienced in securing proper ventilation for dining cars. The same type, however, with slight modifications can be used to equal advantage in connection with the Garland system now in use on Pullmans and coaches.

The Garland exhaust type ventilator which was developed six years ago (described in THE HEATING AND VENTILATING MAGAZINE for December, 1909) proves entirely adequate so long as the train is in motion, but its functions cease with the stopping of the train. Consequently a sufficient amount of ventilation is not provided while the train is waiting in the station.

It is apparent that inadequate ventilating conditions should not exist in dining cars, as the cooks begin operations two or three hours before the car is under motion and, unless the car is equipped with blower ventilation, the air is soon filled with steam, smoke and obnoxious odors from the kitchen.

The accompanying design illustrates the construction of the combination blower and exhaust ventilator which is used as a supplement to the standard ventilator.

This ventilator which combines the action of the blower exhaust with that of the automatic ventilator, induces an added flow of air through the car, increasing the efficiency of the blower about 15 per

FIG. 1.—COMBINATION GARLAND BLOWER VENTILATOR.

cent. This is directly due to the action of the exhaust from the blower which is driven against the curved lip shown as a dotted line in Fig. 2, creating a whirling motion in the exhaust, which draws the air out through the unrestricted openings of the automatic ventilator.

Simultaneously with the starting of the train, the automatic ventilator begins to perform its functions, increasing its action correspondingly with the increased speed of the train. Upon reaching normal speed the generator equipment, the motor of the blower is automatically cut off and the blower ceases operation. The ventilation is then maintained by the automatic ventilators, which continue to operate until the train slows down at the next stop, when the automatic switch will again place the blower in operation until such time as the train has again attained sufficient headway to successfully operate the automatic ventilators.

Tests have shown that each blower ventilator unit, in both kitchen and dining room exhausts 33,000 cu. ft. of air per hour, at total of 66,000 cp. ft. for the car. When the car is at rest this is sufficient to maintain a fairly good ventilation.

After the train attains a speed of 50 miles per hour the automatic ventilators will remove 140,000 cu. ft. per hour from the dining room and 100,000 cu. ft. from the kitchen, a total of 240,000 cu. ft. per hour.

While the capacity of the kitchen is but 600 cu. ft. and that of the dining room is 2,600 cu. ft., there are five exhaust ventilators in the kitchen against seven in the dining room. There is thus a constant flow of air toward the kitchen eliminating the possiblity of the kitchen odors entering the dining room. To further decrease the possibility of a flow of air from the kitchen, the dining room blower ventilates from a decorative screen located in the arched panel directly over the passageway in front of the buffet. This ventilator is designed to draw the air from the car toward the kitchen, and also to catch any gases which might possibly escape the kitchen blower.

The blower employed in this unit is a special railway car ventilator blower manufactured by the B. F. Sturtevant Co. and is designed so that the blower wheel can be taken out either through the air intake opening or by removing the motor; thumb screws being used which enables cooks to remove and clean the wheel without the use of tools.

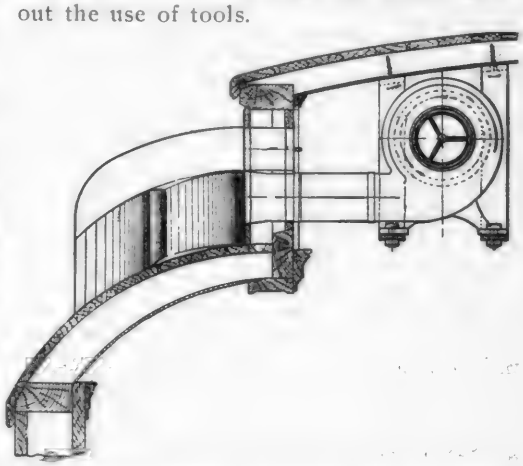


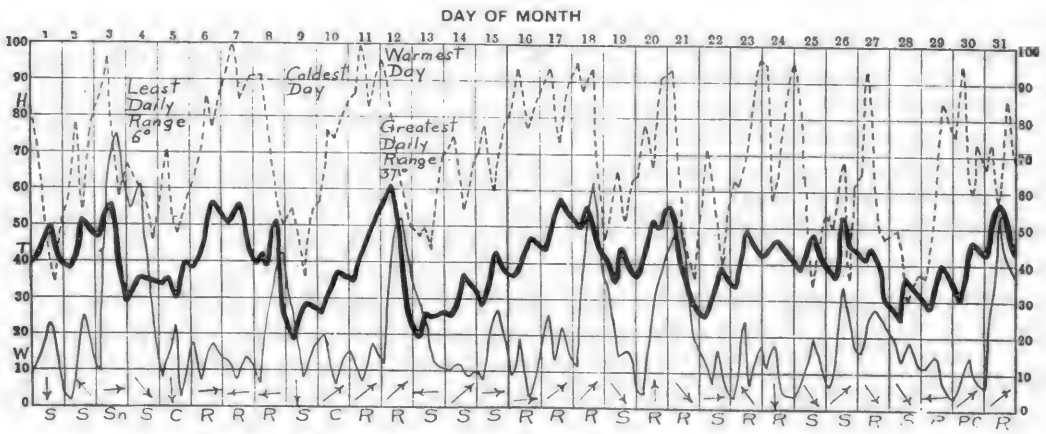
FIG. 2.—SHOWING POSITION OF BLOWER.

The facility with which the blower wheel may be removed and cleaned is an important consideration, for the exhaust passing through the blower is heavy laden with greasy steam and particles of carbonaceous matter, necessitating the frequent cleaning of the blower to insure satisfactory operation.

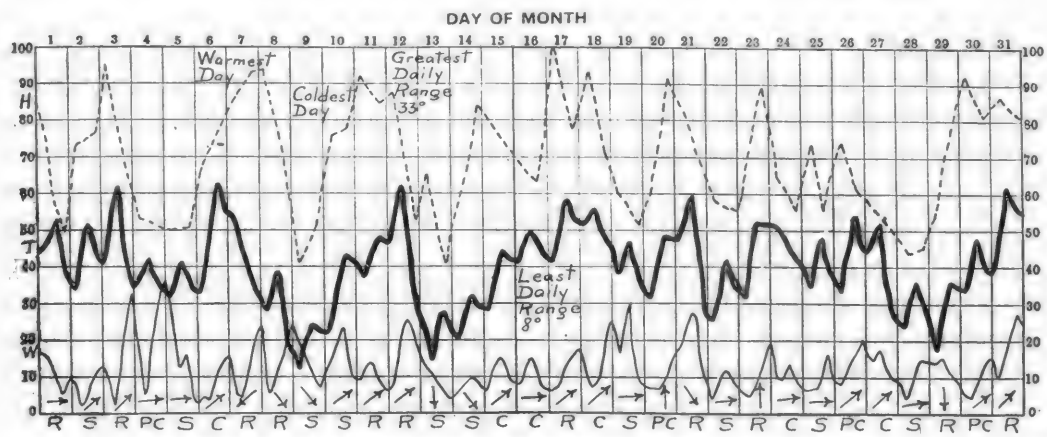
The Electron Theory of Magnetism, by E. H. Williams, has just been published as Bulletin 62 by the Engineering Experiment Station of the University of Illinois. This is a mathematical discussion of the new theory of magnetism. The bulletin traces the experimental evidence leading to the development of this theory, defines its present status, and points out certain phenomena which the theory in its present form fails satisfactorily to explain. Copies of the bulletin may be obtained from W. F. M. Goss, director of the engineering experiment station of the university, Urbana, Ill.

The Weather for January, 1913,

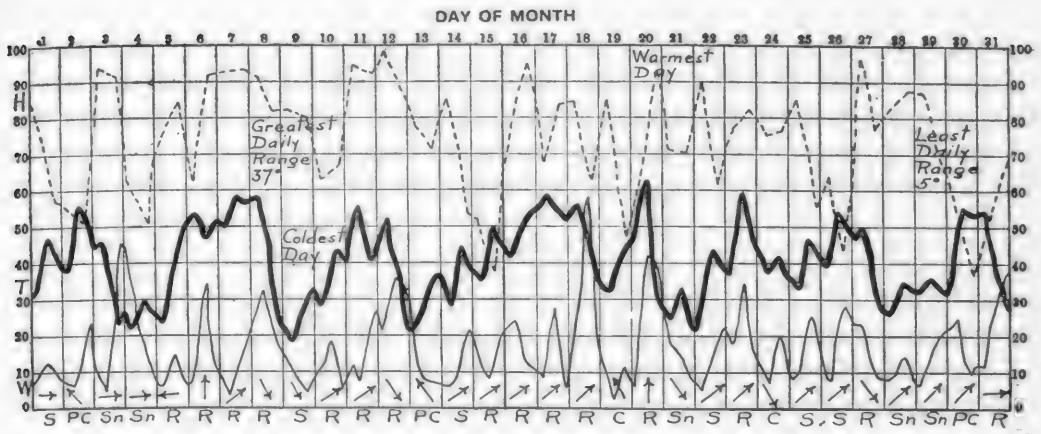
	New York.	Boston.	Pittsburg.	Chicago	St. Louis.
Highest temperature, degrees F	61	62	63	55	64
Date of highest temperature	12	6	20	17	19
Lowest temperature, degrees F	18	13	19	..	7
Date of lowest temperature	9	9	9	12	12
Greatest daily range, degrees F	37	33	37	32	43
Date of greatest daily range	12	12	8	20	20
Least daily range, degrees F	6	8	5	2	5
Date of least daily range	4	16	29	7	17
Mean temp. for month, degrees F	40	39	40	29.3	35
Normal mean temp. for month, deg. F	30	27	30.7	23.7	31
Total rainfall, inches	2.77	2.38	5.28	1.33	4.34
Total snowfall, inches	0.3	0.3	9.3	6.1	tr ce
Normal precipitation, this month, in	3.79	3.82	2.87	2.0	2.27
Total wind movement, miles	13,836	9,155	9,730	11,191	9,647
Average hourly wind velocity, miles	18.6	12.3	13	15	13
Prevailing direction of wind	SW.	SW.	SW.	S.	S.
Number of clear days	11	11	7	4	9
Number of cloudy days	16	14	19	17	15
Number of partly cloudy days	4	6	5	10	7
Number of days on which rain fell	16	11	20	15	12
Number of days on which snow fell	2	1	5	7	1
Snow on ground at end of month, in	none	none	trace	0.1	none



RECORD OF THE WEATHER IN NEW YORK FOR JANUARY, 1913.
(Hourly Observations of the Relative Humidity Are Plotted on this Chart.)



RECORD OF THE WEATHER IN BOSTON FOR JANUARY, 1913.


DAY OF MONTH
Warmest Day
Greatest Daily Range 37°
Coldest Day
Least Daily Range 5°
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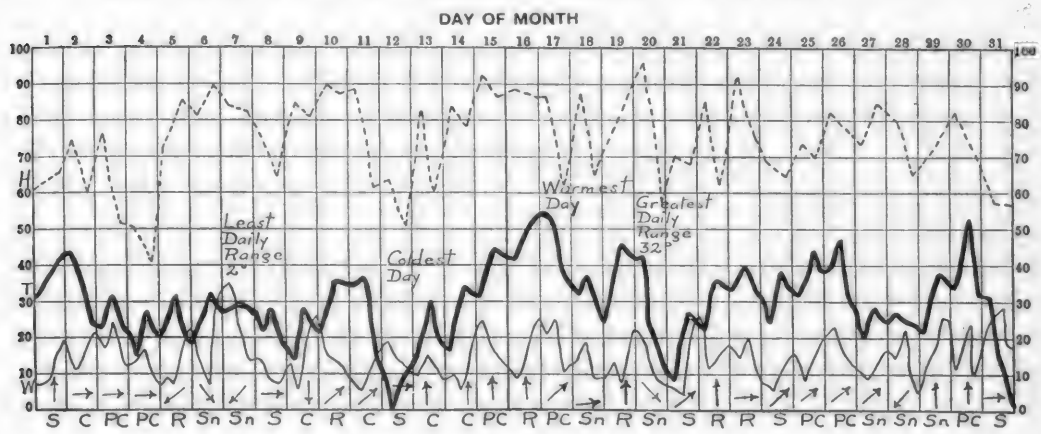
W
S PC Sn Sn R R R R S R R R PC S R R R R C R Sn S R C S S R Sn Sn PC R

RECORD OF THE WEATHER IN PITTSBURG FOR JANUARY, 1913.


DAY OF MONTH
Least Daily Range 2°
Coldest Day
Warmest Day
Greatest Daily Range 32°
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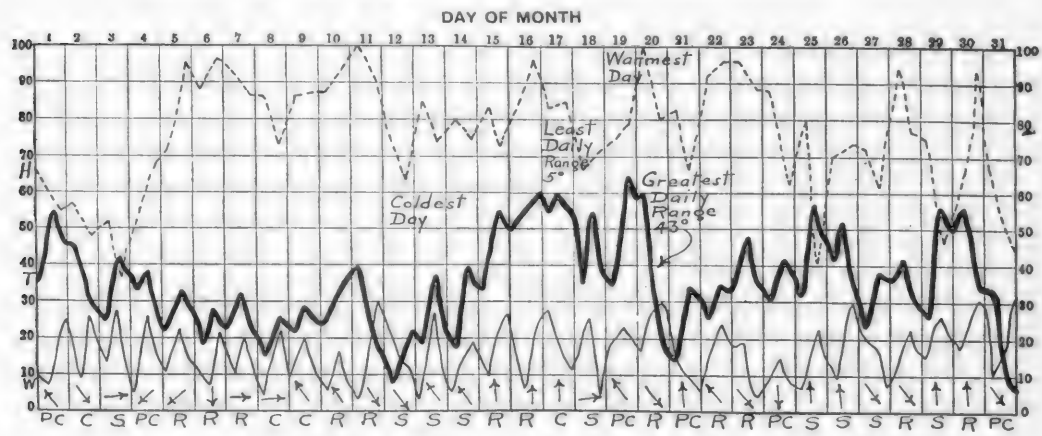
RECORD OF THE WEATHER IN CHICAGO FOR JANUARY, 1913.


DAY OF MONTH
Warmest Day
Least Daily Range 5°
Coldest Day
Greatest Daily Range 43°
H
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Pc C S PC R R R C C R R S S S R R C S Pc R PC R R PC S S S R S R Pc

RECORD OF THE WEATHER IN ST. LOUIS FOR JANUARY, 1913.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Discusses Loft Ventilation.

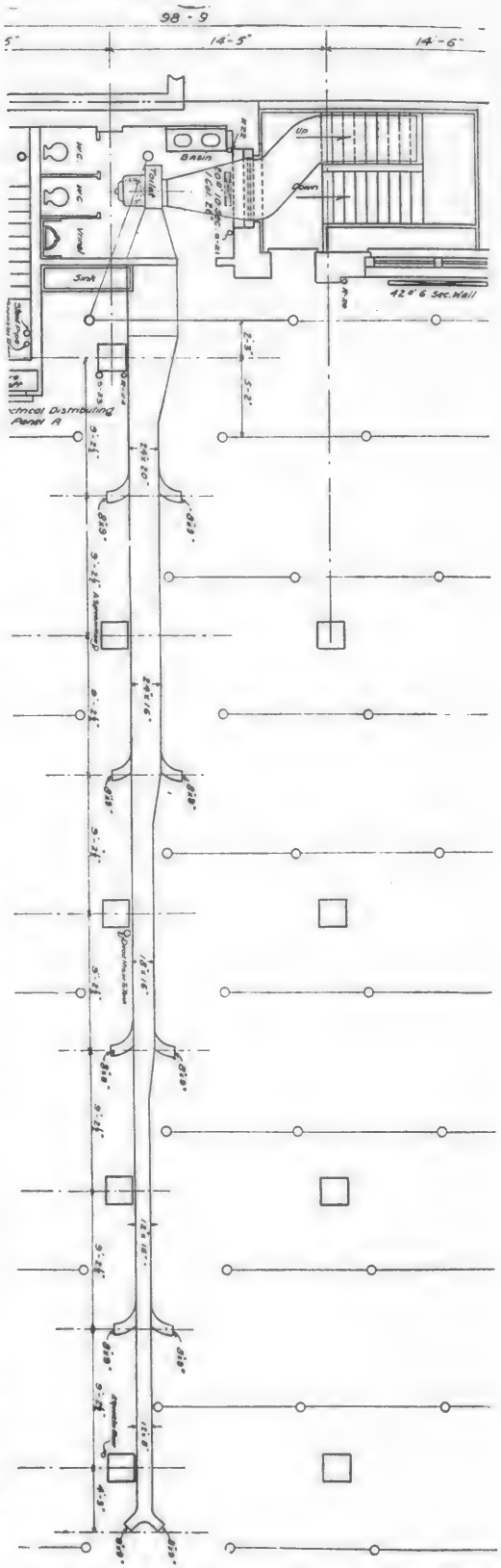
Loft ventilation, with a paper on the subject by Walter S. Timmis, accompanied by a plan showing such a system in the Graphic Arts Building, New York, was the topic for discussion at the February meeting of the New York Chapter.

Mr. Timmis spoke first of the conditions in lofts, where the heating apparatus is generally designed to heat the loft to 70° F. in zero weather. This, he said, usually results in the overheating of the loft most of the time, due to the fact that zero temperatures are rarely recorded, and it is not customary to include heat control in such work. Even when few persons are in the loft, he said, the odor of stuffiness is very apparent. Opening of windows is not always possible.

In the case of the Graphic Arts Building, the ventilation system was designed to admit air to meet any specific requirement. This building occupies a plot 126x98.9 ft. and is 12 stories high, each floor being 13 ft. high, with a floor space of 10,000 sq. ft. The building is exposed on all sides. The ventilation system, which is designed on the "unitary" plan, is sufficient to supply 150 employees on each floor, although there are seldom over 100. Under these conditions the system is capable of supplying 300,000 cu. ft. of air per hour, or 5,000 cu. ft. per minute, giving each occupant 2,000 cu. ft. per hour. This is accomplished by a No. 5 multivane fan of Sturtevant Co. make, drawing air through an intake located on the fire escape and over steam-heated Vento sections, thence through sheet metal ducts into the loft. Each floor is equipped with such a system so that each forms a unit in itself.

In designing the system, which is operated and connected with a direct radiation system for heating alone, it was figured to install one-half of the necessary radiating surface in the form of direct radiation on the typical floors and on the first floor. The balance of the heat required is furnished by the hot blast system. This arrangement makes it essential to run the fan. The direct radiation is in the form of Colonial wall radiators.

In every case the ventilating apparatus is on the ceiling, the fan being mounted on the ceiling of the toilet, where it is enclosed, and operated by a 2 H. P. electric motor. In most cases 268 sq. ft. of Vento radiation was installed, built in five sections, each section separately valved, with



DETAIL OF VENTILATION UNIT FOR LOFT BUILDING.

a Dunham steam trap on each return. The air changes were figured as one in 2 hrs. The air velocity in the main duct in each case is 1,200 ft. per min. and that in the branches, 800 ft. The main duct is 24x20 inches.

The cost of the installation was from 30% to 35% in excess of that for an ordinary direct system.

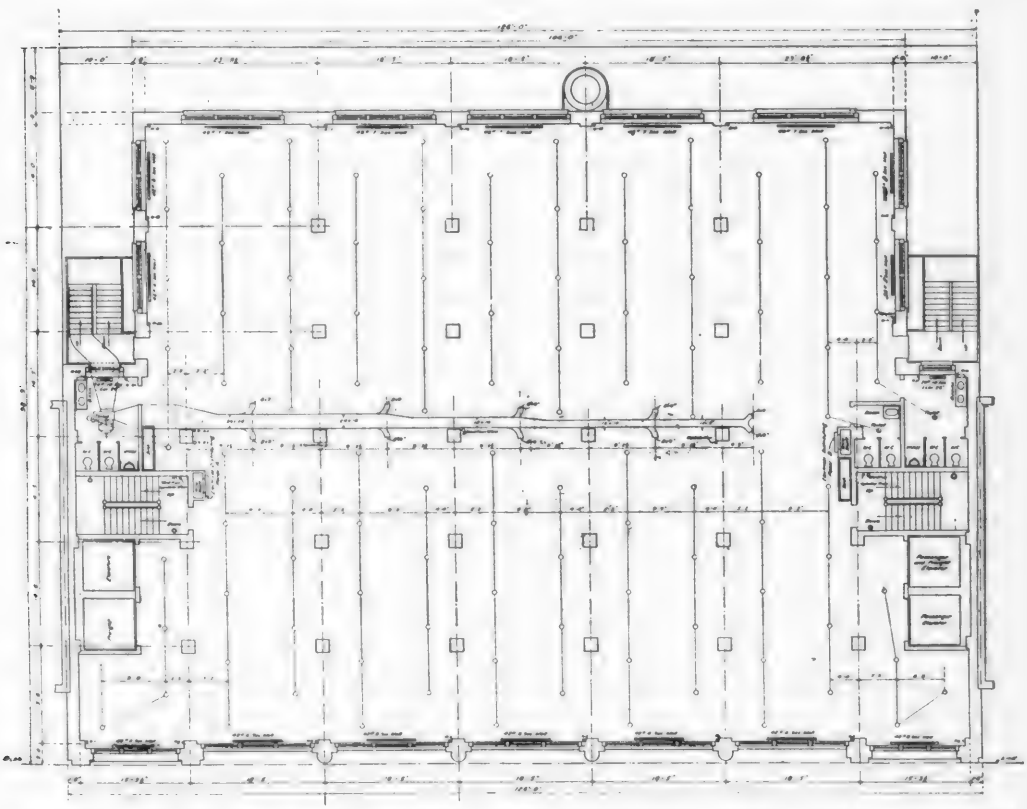
There is no exhaust ventilation with this system, it being designed to secure ventilation by dilution. In this respect, the speaker said, it can be used with open windows for no attempt is made to automatically control the temperature. When the outside temperature is above 32° the fan system alone is sufficient to heat the loft.

In concluding his remarks, Mr. Timmis expressed the opinion that air movement is quite essential for good ventilation. For that reason, he added, he would consider it a misfortune, if the New York State legislature, which is now considering laws in connection with factory ventilation, does not specify the minimum amount of air to be supplied in loft buildings and factory buildings.

An animated discussion followed the presentation of the paper.

Thomas Barwick called attention to the fact that in lithographing work, the machines will not register accurately unless the temperature is uniform at from 65° to 70°. J. A. Donnelly asked if there will not be an outflow of air through the intake when the fans are not running to which the author replied that no provision had been made for this, as it would not necessarily be an objectionable feature in that it would augment the natural ventilation.

In reply to a question relating to the presence of static electricity in the paper in printing shops, Mr. Timmis stated that where air washers were used the air conditions were much more stable and that where a relative humidity of 55% is maintained with the temperature between 65° and 80°, there is no trouble experienced with static electricity in the paper. Answering a query of W. W. Macon as to the adaptability of the system to buildings already built, having power plants and limited boiler space, Mr. Timmis said that the system could be installed on any floor of



TYPICAL FLOOR PLAN OF GRAPHIC ARTS BUILDING, NEW YORK, SHOWING UNIT SCHEME OF LOFT VENTILATION.

any building and that ordinarily the boiler capacity would be sufficient to take care of it.

Previous to the reading of the paper a business session was held at which J. A. Donnelly presented the report on the salaries to be recommended by the chapter for city employees engaged in engineering work. The report will go to the chapter's board of governors before being finally adopted.

CHAPTER APPOINTS COMMITTEE ON TESTS.

On the proposal of Mr. Donnelly it was voted that the chapter have a committee on tests to be composed of five members. President McCann appointed on this committee: D. D. Kimball, W. W. Macon, J. A. Donnelly, W. H. McKiever and W. S. Timmis. The scope of the committee's work was not determined, but it was the general consensus of opinion that its activities could properly include the testing of systems rather than apparatus and in formulating methods of testing.

It was voted to hold the chapter meetings hereafter on the third Monday of the month, instead of the second Tuesday. Provision was also made for the holding of the meetings on other nights if desired.

The election of the following new members was announced by Secretary Joseph Graham: John F. Carney, A. A. Kiewitz, C. N. Flagg, Jr., E. A. Scott, H. G Issertell (associate) and J. F. Hanbury (junior).

Massachusetts Chapter Drafts Separate Contract Bill.

Considerable progress was reported at the February meeting of the Massachusetts Chapter on the matter of securing the separation of heating and ventilating contracts from the general contracts in that State. The legislative committee, composed of Messrs. Cooper, Myrick, Franklin and McKenna, after conferring with others interested, reported that it had drafted a bill which is entered as "Senate No. 115, Relative to the Making and Awarding of Contracts by Counties, Cities, Towns and Commissions Thereof," for the separation of the heating and ventilating contracts from the general or other contracts. The adjourned hearing was set down for February 18, before the Municipal Finance Committee.

The subject of a proposed law governing conditions in moving picture theatres was laid over until the March meeting, and it was voted to invite three of the State building inspectors and a theatre owner to participate in a further discussion of the subject at the March meeting.

In connection with the territorial jurisdiction of the chapter as regards membership, it was decided that all of New England west of the Connecticut River belongs to the New York Chapter, in accordance with a general rule of business houses having offices in New York and Boston.

February Meeting of Illinois Chapter.

"Expense of Operating Heating and Ventilating Plants," was the topic for the February meeting of the Illinois Chapter, which was held in Vogelsang's Restaurant, Chicago, February 10. H. M. Harte, of the L. H. Prentice Co., discussed operating costs for heating plants in flats and office buildings, as well as in residences. G. W. Hubbard, of the D. H. Burnham Co., also spoke, giving his methods for estimating the cost of maintenance from the plans. The meeting was in charge of H. M. Harte, chairman; N. L. Patterson and G. W. Hubbard.

The March meeting, held March 10, was to be devoted to description of the tests being made in the experimental room of the Chicago Normal School by F. W. Shepherd, coupled with a report by Dr. W. A. Evans on the progress of compulsory ventilation laws.

CORRESPONDENCE

Ventilation for Loft Buildings.

Editor HEATING AND VENTILATING MAGAZINE:

Referring to the recent meeting of the New York Chapter and the discussion of loft ventilation as applied in the Graphic Arts Building, the question of occupancy payment for ventilation was discussed with the evident concensus of opinion that the tenant should be responsible, as the owner has no foreknowledge of the eventful lease, but the problem of the engineer is to so establish his plant so as to provide for such occupancy.

This brings the matter very forcibly before the public and before the renting commissioners who look after individual properties. The discussion brought out the fact that there are various branches of manufacture that will require different treatments and one of the speakers stated that it would be impracticable to procure definite legislation on this matter. I cannot

agree with this. Legislation requirements, I feel, from a hygienic and sanitary point, must be complied with for the health and better efficiency of the occupants and, while it will be somewhat difficult to place a minimum standard, I feel that we, as progressive men, can establish a fair normal standard at which any area can be properly supplied with fresh air.

I am, of course, in favor of the practice of the induction of air into lofts in preference to the exhausting of same, as the ventilation is the admixture of fresh air to dilute the foul and to counteract the effect of contamination.

But as lofts are usually kept closed, except for the opening of windows, I think that some two-thirds of the input should be provided for in a mechanical exhaust system.

Elevators as constructed at present are enclosed and are opened infrequently and the same is true with stairways. Therefore, when such openings are closed, if the windows are not opened, there will be a churning of air in the fans and the volume will be insufficient. Window opening does not particularly affect the inflow of air, but often disturbs the outflow; therefore, the problem of open windows should never be considered in any ventilating plant, even in school work, except that some judgment must be used in opening same on the windward sides. The need of this is apparent in many buildings in which exhaust vents are provided. The force of the wind pressure through the window may increase the outflow from some rooms and entirely shut off the outflow from rooms opposite, on the leeward side, and if the vent ducts enter exhaust chambers which are common to both rooms, there will probably be a downflow of air in the vent flue.

In the arrangement designed for the Graphic Arts Building, the centralizing of the induction ducts is proper for open loft work and, from my experience in the same line, the velocity arrangements are not too high, but if lofts are sub-divided, or if special manufacturing forms are required, the system would have to be modified to suit the conditions.

Velocities of from 900 to 1,000 feet through air openings project the air and cause stratification and not diffusion. Low velocities diffuse the air and, even with high velocities in the exhaust ducts, cause very little stratification.

Referring to the matter of charges for the ventilation, the owner is not an interested party except insofar as he provides the necessary capacity in his building to supply the occupancy, ether in the form of electricity, steam, water or gas. But the occupant, unless by special arrangement, should be responsible for his output in these branches.

It has become the custom in most buildings to supply heat which is made a part of the lease, but this does not apply outside of the ordinary comfort of the loft or apartment. The law at present compels the owner to provide a temperature of 70° F. as has been shown in recent court decisions. Outside of this requirement, the law makes it incumbent on the tenant to provide proper air conditions.

THOMAS BARWICK.

New York, Feb., 1913.

Discussion of Electrical Heating Apparatus for Boston Residence.

Editor HEATING AND VENTILATING MAGAZINE:

The "kicker" in almost all lines does good now and then. I notice in your February issue an account of an apparatus for conditioning the air of a Boston Residence and I recommend the article to everyone who undertakes so complex a question as the warming, ventilation, humidifying and ozoning of the air of a residence by electricity or by any other method.

What I desire to protest about is the putting of any such apparatus in a roof space—or any other space—that is only 3 ft. high. The restricted space will kill the most complete and perfect apparatus that can be devised. No engineer should be satisfied with any space for his apparatus in which an ordinary man cannot stand upright. An engineer or attendant must be able to get to his apparatus in an upright position or he will neglect it. An apparatus cannot receive proper attention from an attendant who has to approach it on all-fours or on his knees.

Several arrangements, such as Mr. Cooper describes (except that steam is used as the heating medium), have come under the writer's care recently and, on account of the restricted room and want of light, they will never reflect credit on the makers of the apparatus or on the man who installed them.

My general criticisms also apply to "tunnel work" and "pipe galleries." They should be at least 6 ft. in height and wide enough, when all the pipes are in place, to allow free passage on foot and room for sufficient room for the use of tongs and wrenches.

We all suffer from the neglect of our apparatus. Let us do all we can not to contribute to the neglect of our work.

WILLIAM J. BALDWIN.

New York, February, 1913.

Legal Decisions

Employer's Duty as to Safe Appliances.

Action was brought for the death of an employe employed in the installation of a heating system in the Pullman plant at Pullman, Ill. The building was a one-story carshop. Sidelights extended nearly across the building. A ventilator house about 15 ft. square was located on the roof at the south end of one of the skylights. A door opened from the south side of the ventilator house onto the roof. A window was in the north side of the ventilator house opening into the area under the skylight. On the day of the accident the defendant, with a foreman and five workmen, were installing heaters in the ventilating house. A heater consisted of five sections of radiator coils. Each section was 7 ft. high, 6½ ft. long, 8 in. wide and weighed about 800 lbs. In placing in position the south heater it was necessary to raise it to put a roller under it. The foreman sent the men for a couple of planks. Two planks were got, 2 in. thick, 10 in. wide and about 12 ft. long. They were used as prys, and after placing the south heater in position the planks were used on the north heater. They had to be stuck out of the window, resting on the window sill for a fulcrum. The foreman then ordered three men out onto the planks. The deceased was sitting on one of the planks when it broke near the window sill and the deceased fell with the plank, struck on his head on a hand car and died immediately.

It was contended that the deceased assumed the risk, but it was held as it appeared that the deceased in going out onto the plank was obeying the order of the foreman; he did not assume the risk. Nor was he guilty of contributory negligence. There was no patent defect in the plank; it was a clean, fresh break. Its use as a pry in such a dangerous place was not an ordinary use. It was the defendant's duty to exercise reasonable care to see that the plank used as a pry in a dangerous place was reasonably safe for the specific use to which it was put by the defendant's order; and the deceased, in the absence of notice, had the right to rely upon the performance of such duty by the defendant's foreman before he gave the order to use the plank in that dangerous manner and place. The jury were held justified in finding from the facts and circumstances that the deceased as an ordinarily prudent man, under the circumstances, did not know or appreciate or in the exercise of ordinary care would not know or appreciate that the instrumentality which resulted in his death was of such a character as might result in his injury. Judgment for the plaintiff was affirmed.—Devine vs. Mathis Bros. Co., 160 Ill. App. 122.

Breach of Warranty—Measure of Damages Where New Furnace Installed.

Where the question was as to the measure of damages for breach of warranty of a furnace where a furnace which was satisfactory had been furnished by the buyer, it was held that the measure of damages in case the jury found there was a warranty of the furnace was the difference between what it would have been worth had it been as warranted, and its actual value as it in fact turned out to be, regardless of the value or cost of the new furnace which was put in to replace it. The new furnace might have been worth much less than the original furnace had that heated the same house to satisfaction. The original furnace might have been a much more durable and better constructed furnace, and had much more intrinsic value, when it worked satisfactorily, than the one which replaced it. The fact alone that the new furnace heated the house to satisfaction was not proof that it was of greater value than the original furnace had that also heated the house to satisfaction.—Mair vs. Williams, South Dakota Supreme Court.

Infringement of Rubber Packing Patent.

In a suit for injunction by the manufacturers of a rubber packing for which they used the trademark and name of "Rainbow" packing, it appeared that the defendants were in the business of manufacturing and selling steam heating and hot-water pipes, etc., and that it was a part of their business to use a material known as "red packing," that they purchased from a stranger, who had been recommended to them, certain spurious "Rainbow" packing, which resembled the red packing they had been using in their business, the purposes of which it answered, and they also sold some of it.

On their attention being called to the infringement, they disclaimed any guilty knowledge, and offered to cease the use and sale thereof. They disclosed their business books, showing that they had only sold some 13 items of the packing aggregating $44.07, including a sale to a representative of the complainant, when they first

learned that the packing was an imitation. It was held that there was no suspicion of fraudulent conduct on the part of the defendants, but that the complainant was entitled to an injunction restraining further sales, and to an order for the destruction of the spurious packing, but was not entitled to damages, as the defendants had acted in good faith.—Peerless Rubber Co. vs. Nichol, Ohio Circuit Court.

Heating of the D. & H. Railroad Shops. Watervliet, N. Y.

Five of the new buildings composing the railroad shops of the Delaware & Hudson Co., at Watervliet, N. Y., are heated by a hot blast system, the apparatus consisting of heated coils, fans, motors, and systems of galvanized iron piping for distributing the heated air. All of the apparatus is situated above the lower members of the roof trusses, and is from 30 to 50 feet above the floor.

As practically all of the floor space of these shops is utilized continuously and as the entire floor of every building is served by traveling cranes, it was necessary to place the heating apparatus entirely above the cranes. The arrangement utilizes no otherwise useful space, as the entire piping system is located in the roof trusses with vertical drops along the walls and columns.

The buildings in which the hot blast system of heating was used, are the freight car shop, having two sets of apparatus, the hammer shop, the planing mill, the foundry and the main shop, the latter being heated by eight sets of apparatus. The weights of the fans, heaters and galvanized iron used in these thirteen sets totals 55,000 lbs. for fans, 332,000 lbs. for the heaters and 105,000 lbs. of galvanized iron.

The apparatus was erected during the winter weather of 1911 and 1912, and was completed in July, 1912. Anxious to rush the work to completion as fast as possible, it was necessary to erect the apparatus in the main building before the walls and roof were in place. The severity of the weather at times necessitated a suspension of the work, as reports from the superintendent in charge showed that for days at a time the melting snow from the roof would form a glare of ice over the iron work. A wind of 82 miles an hour during cold weather was reported at one time, and caused a suspension of work for several days.

Under such conditions as these, it was almost impossible to make rapid progress with the erection. In installing the 53 tons of galvanized iron piping no staging

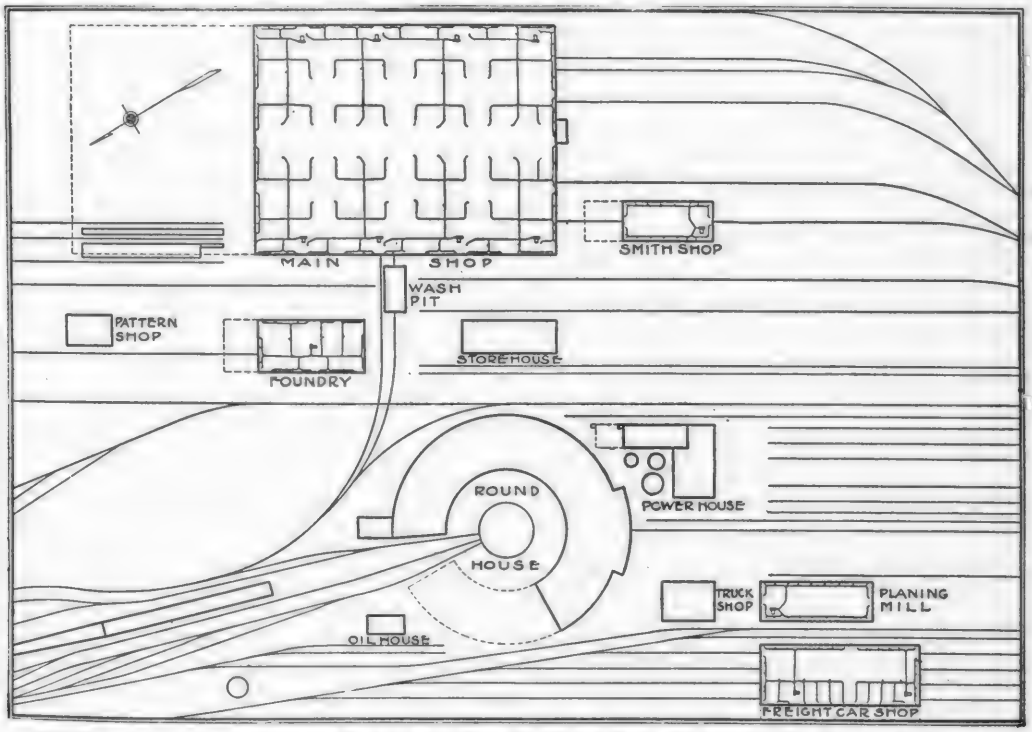
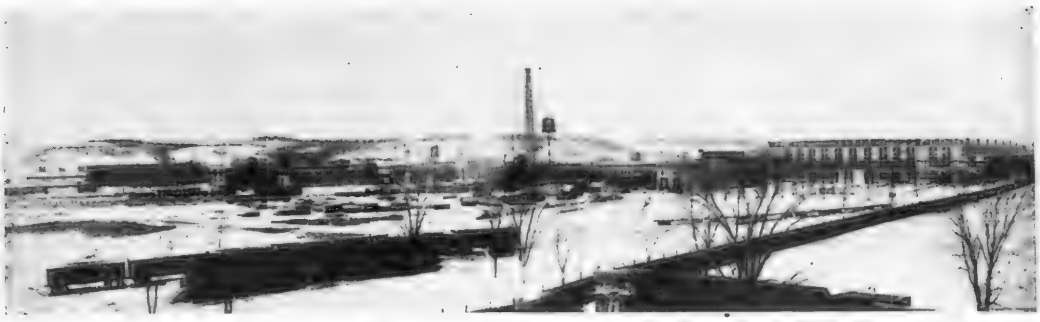


DIAGRAM OF HOT BLAST HEATING OF DELAWARE & HUDSON RAILROAD SHOPS AT WATERVLIET, N. Y.



DELAWARE & HUDSON RAILROAD SHOPS AT WATERVLIET, N. Y.

was used with the exception of one instance when a branch connection requiring about a week's work was erected. The cranes, which are immediately below the roof trusses supporting the heating ducts, supplied the lack of staging in many instances.

The ducts are run through the roof trusses, being supported by the lower members and are held in place by iron straps. The galvanized iron piping was built in the B. F. Sturdevant Co.'s. shops and shipped in sections to Watervliet. In erecting these galvanized iron ducts as as long as a duct as could be conveniently handled was assembled upon the flooor and then hoisted into position. All of the piping was riveted and soldered.

The fans and heaters were arranged upon platforms situated in the roof monitors. These platforms are built of 5-in. steel I-beams, upon which are placed 5-in.x10-in. wooden beams, and a flooring of 31-in. planking. In Fig. 1 which shows a plain view of a portion of the railroad yard containing the shops, there will be found indicated the general outline of the heating system in the five shops which are heated by the hot blast system. The table given below summarizes the apparatus furnished for the buildings, giving the sizes, capacities and speeds of the fans, the heating surface of the heaters and horsepower of the motors.

The fans which are of the steel plate type and built by the B. F. Sturtevant Co., are all belt driven by General Electric alternating current induction motors. Vento radiation was used throughout the entire installation. Fig. 2 gives a general view of the shops as they appeared in the spring of 1912.

The engineering department of the Delaware & Hudson Railroad Co., Mr. Caracristi, consulting engineer, and Mr. Coutant, chief draftsman, designated the buildings and the heating arrangements. Their calculations were carefully checked by the engineering department of the B. F. Sturtevant Co., which built and erected the heating system. The fans, heaters and galvanized iron piping were chosen to conform to the standard practice of this company.

Ventilation of the House of Commons.

It is reported that a committee is shortly to be appointed to inquire into the system of ventilation of the House of Commons in London. Members of Parliament are now being canvassed to sign a request to that effect.

HEATING APPARATUS IN THE WATERVLIET SHOPS.

Fan, Sturtevant steel plate	Apparatus No.	Size, inches diameter	Volume C.F.M.	R.P.M.	Heater, Vento, Sq. ft.	Motor, G.E., H.P.
Main Shop	1	160	40,000	199	3,360	22
" "	2	160	40,000	199	3,360	22
" "	3	120	28,000	260	2,688	12
" "	4	120	28,000	260	2,688	12
" "	5	120	28,000	260	2,688	12
" "	6	120	28,000	260	2,688	12
" "	7	120	28,000	260	2,688	12
" "	8	120	28,000	260	2,688	12
Hammer Shop	1	110	21,000	290	1,904	10
Freight Car Shop	1	160	40,000	199	3,360	22
" " "	2	160	40,000	199	3,360	22
Planing Mill	1	120	28,000	260	2,016	12
Foundry	1	140	36,000	228	3,360	18

Modern Vacuum Cleaning Apparatus

5—Richmond Vacuum Cleaners

The Richmond Radiator Co., New York, which recently purchased the assets of the McCrum-Howell Co., is now manufacturing the complete line of Richmond vacuum cleaning machines. It is the plan of the manufacturers to carry stock machines suitable for use in buildings of all kinds and sizes, with the result that the Richmond line includes over 50 different sizes and types of machines. A brief outline of each distinctive type is given herewith.

The Richmond portable machine is operated by electricity and is intended for light household service. It weighs slightly over 10 lbs. The complete machine, including the centrifugal fan and ⅛-H. P. motor, is manufactured by the company. This company also makes a large portable machine, equipped with a ¼-H. P. motor, direct-connected to a four-stage centrifugal turbine. This outfit is intended for heavy service and can also be used as a stationary plant in small dwellings by making a hose connection to a stationary riser, with inlets on each floor.

1 H.P. DIRECT-CONNECTED ROTARY PUMP.

Direct-connected rotary pump plants are made in 1 and 2-H. P. sizes, being intended for permanent installation in residences, large and small, and in other buildings of medium size. On these machines the vacuum producer is a two-blade positive rotary pump, capable of maintaining a comparatively high vacuum, at the same time displacing a large volume of air, a condition which has been referred to as an ideal one for efficient cleaning. The simplicity, compactness and quiet running of these machines are emphasized by the makers. The lubrication system is automatic, the oil reservoir containing about 2 gals. of oil, which is distributed to the pump automatically when the plant is in operation. After passing through the pump, the oil is separated and returned to the reservoir so that it is used over and over again, thus serving to make it economical and positive, and capable of being operated several months without attention.

Another unique feature is the self-cleaning dust separator which automatically empties the collected dirt into a metal drawer with outside handle. It is, therefore, possible to remove the collected dust conveniently and without scattering the dirt. This dust drawer is so arranged that it opens automatically when filled, thus breaking the vacuum and preventing any further cleaning work until the drawer has been emptied. This type of machine is direct-connected, eliminating all belts and gears.

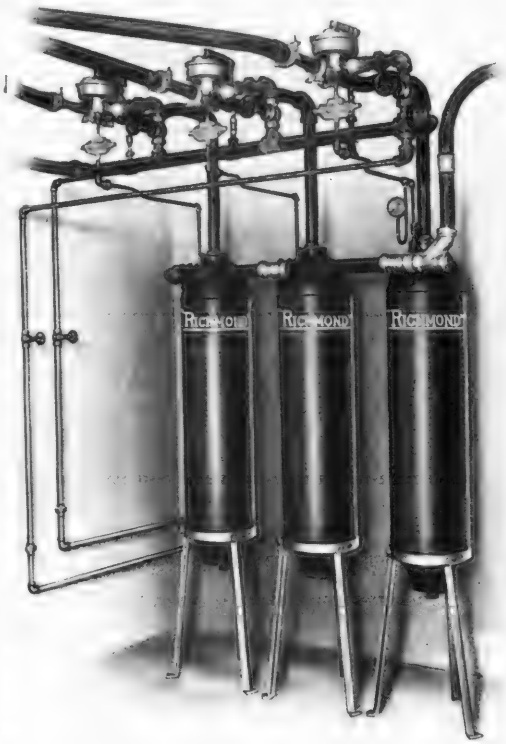
The company's chain-driven rotary pump plants are made from one sweeper capacity up and are designed for heavy service in large buildings. The pumps are of the positive rotary type, capable of maintaining a high vacuum, at the same time displacing a large volume of air. The smallest size machine is equipped with a 3 H. P. motor for one-sweeper capacity. These machines are also equipped with the automatic lubrication system, which is said to make unnecessary the services of an expert engineer.

Two dust-separating tanks are included in the equipment, the first or centrifugal tank retaining about 95% of the dust, the remainder being caught by the second tank containing a bag strainer. Both separators are of the "dry" type, thus eliminating all water connections and the possibility of cloggage by mud in the pipe lines. This type of machine is also equipped with an automatic unloading device which is particularly applicable in machines of more than one-sweeper capacity. This device

serves to proportion the power consumption very closely according to the work being done, so that a four-sweeper plant, for instance, will use about one-fourth the current when only one sweeper is being operated. The machine is recommended for use in school buildings, office buildings, etc., where heavy service plants are required.

Steam aspirator plants are made in various sizes from one-sweeper capacity up and have been found exceptionally efficient, both as to steam consumption and in connection with cleaning work. A minimum steam pressure of 65 lbs. is required for efficient and economical operation. A unique and important feature of this system is the automatic steam cut-off device which instantly closes the steam valve when the operator closes the air inlet valve, no matter how far away this may be, resulting in a power control system which proportions the power used to the actual work done.

With this system it is possible to maintain a vacuum in the dust separators and through the piping system at practically no expense, so that the operators throughout the building can attach the hose lines and begin cleaning at any time during the day or night. As soon as a connection is made, the steam turns on automatically in order to maintain the desired vacuum. In a six-sweeper machine, for instance, the steam would be turned on approximately one-sixth of the time with one sweeping tool in use, one-third of the time with two tools in use, and so on.

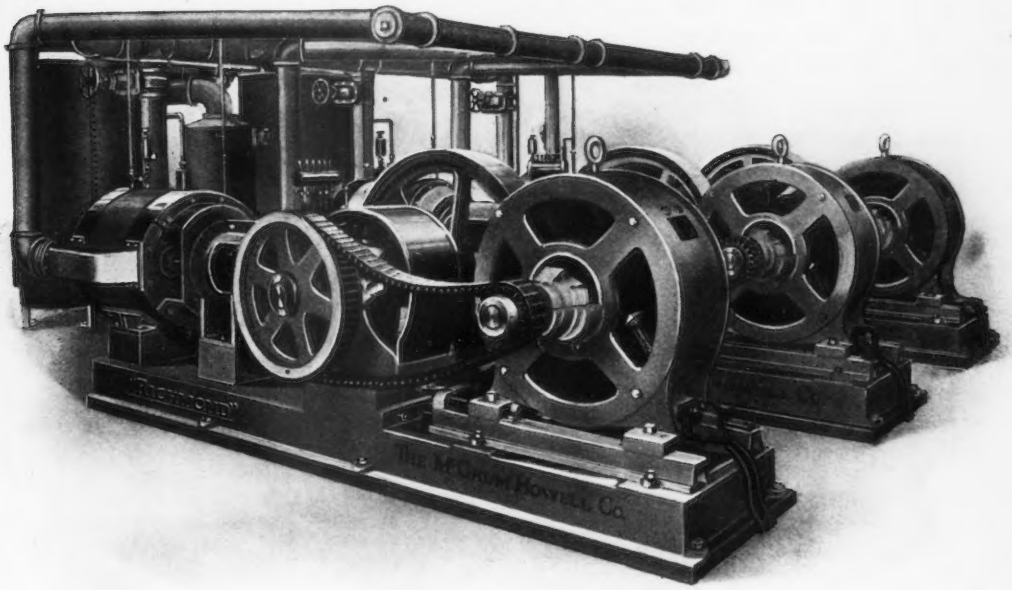


THREE 2-SWEEPER ASPIRATOR UNITS IN PARALLEL

3 H. P. CHAIN-DRIVEN ROTARY PUMP.

In cases where plants are required of from 12 to 30, or even 50-sweeper capacity, several aspirators can be connected in parellel so that one will help out the other automatically, as greater demands are made on the system. Other advantages mentioned in connection with this system are the low initial cost, the low operating cost and the machine's simplicity so that it requires no oiling or attention except that of turning the main steam valve on or off. Either dry or wet dust separation can be used in connection with these aspirators.

Steam and electric-driven reciprocating pump plants are also included in the Richmond line, running from one-sweeper capacity up to any size required. These pumps are of the single cylinder, double-acting type and are made vertically in the smaller sizes and horizontally in the larger sizes. All of the pumps have been especially designed for vacuum cleaning service,



THREE 12-SWEEPER RECIPROCATING PUMP UNITS AS INSTALLED IN STORE OF MARSHALL FIELD & CO., CHICAGO.

with large piston areas and comparatively short strokes. When electrically operated, the machines are either belt or chain driven; when steam operated, the steam cylinder is mounted between the air pump and the crank shaft, tandem fashion.

The pumps of this type have been found capable of producing an almost complete vacuum. In operation, the power consumption is automatically reduced as the vacuum increases. These plants require more attention with regard to bearings, lubrication, etc., but are notable for their efficiency under heavy, continuous service.

Dust separators of the dry and wet type, in combination, are generally used with this type of vacuum producer, although it is possible to arrange special separators, such as those which discharge directly into the sewer when these are required. These pumps can also be equipped with automatic unloading devices which will reduce the power consumption when the full capacity of the plant is not required. Another efficient method of controlling the power consumption is to equip the motors or steam engines with automatic speed regulating devices, which govern the speed of the pump in proportion to the demands made on the system. This has been found an effective way of regulating the power consumption in every lareg installation.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HYGIENE.

The Hygiene of Building. Percy L. Marks. Read before the Inst. of San. Engrs. Considers the site, ventilation, lighting and warming, planning, materials, etc. 3500 w. Plumb. & Dec.—Dec. 2, 1912. Serial. 1st part. 40c.

SCHOOLS.

Public School Heating and Ventilating. Describes the system in public school No. 46, New York City, as an example of modern methods. 3500 w. Dom. Engng.—Dec. 14, 1912. 20c.

Heating and Ventilation of Mount Vernon High School. Ira N. Evans. Illustrated description of the equipment as designed for a new building. 3000 w. Power —Dec. 24, 1912. 20c.

VENTILATION.

A Symposium on Ventilation. Two full papers and other abstracts of papers read at the Int. Cong. on Hygiene and Demog-

raphy. D. D. Kimball, C-E., A. Winslaw, Y. Henderson and F. S. Lee. Discusses why we should ventilate. 12500 w. Eng. News—Nov. 28, 1912. 20c.

New Books.

Scientific Building Operation, containing some fifty articles written by building managers and owners giving their experiences on renting, management and operation, is a new book published by the Patterson Publishing Co., Chicago. The material was collected and edited by C. A. Patterson and William C. Engel, of "Building Management." The book has been divided into sections, covering such headings as management, renting, accounting and reports, operation, janitor service, repairs, buying supplies, elevators, lighting and insurance. The subject matter is calculated to be of value to architects and owners who contemplate building and who desire to figure out beforehand what their operating costs should be. Cloth, 260 pages. $2.50 net. May be had from the publishers or through the book department of THE HEATING AND VENTILATING MAGAZINE.

Trade Literature.

FOSTER VALVE SPECIALTIES, including pressure regulators and kindred devices applicable to modern high and low pressure plants, are dealt with in a new catalogue published by the Foster Engineering Co., Newark, N. J. This company has the enviable reputation of being an authority in the design and manufacture of pressure regulating and reducing valves and kindred engineering specialties, and the extensive line displayed in this new catalogue is fully in keeping with this firm's reputation. As explained in the catalogue, the company is now confining its attention to the construction of the spring-and-diaphragm type of regulator, as it considers this arrangement superior to the weight-and-lever type. The company also announces that admitted defects in the spring-and-diaphragm types, as heretofore used, have been entirely overcome in the company's latest constructions. The catalogue is profusely illustrated and contains price lists, general information, as well as Foster terms, Foster dont's and order code. Size 6x9 in. (standard). Pp. 112.

THERMOGRADE SYSTEM OF HEAT REGULATION is featured in new circular matter sent out by the Thermograde Valve Co., Boston, Mass. It is explained that the Thermograde is a two-pipe steam system adapted to vacuum or low pressure work, operated either on live or exhaust steam. It employs but one valve, the control, operated in connection with each radiator. The return, or autovalve, is automatic, and is designed to prevent any accumulation of air pressure throughout the apparatus.

ENGINEERING DIRECTORY FOR 1913, being the twentieth annual edition and containing 1,540 pages, 4,000 classifications of manufactured products, together with valuable mailing lists, has been published by The Crawford Publishing Co., 537 So. Dearborn Street, Chicago. The 1913 edition contains lists of jobbers and dealers in mill, steam, mine, heating and lighting supplies, tools and machinery in the United States; jobbers of plumbing, steam and gas fitting supplies in the United States; dealers in plumbing, steam and mill supplies in Canada; manufacturers' agents, representing the mill, steam, mine, plumbing and heating trade; alphabetical list of manufacturers of plumbing, heating, lighting, mill, steam and mine supplies, together with a classified directory of same; leading architects in the United States, trade associations and their officers, cross index to manufactured articles classified in the directory, etc. The price of the directory is $5.00, delivered by prepaid express. Size 4 x 6¾ in., bound in leather, with thumb index and complete cross index.

IDEAL HEATING JOURNAL for February, 1913, the periodical of the American Radiator Co., Chicago, announces plans of the company for a larger output in 1913. The company will shortly place its new plant at Birmingham, Ala., in operation. At the Kansas City plant the erection of new buildings will increase the output at that point 100%. At Buffalo seven new buildings now nearing completion will add 35% to the output of the Buffalo branch. Finally, the company is pushing to completion its largest plant, at Bayonne, N. J., one of the main buildings being already finished. The policy during 1913, as announced, will be to increase the company's facilities by a large percentage, even if it necessitates the carrying over of much surplus stock. The company is also arranging to enlarge its line of Ideal down-draft smokeless boilers, in response to an increasing demand for this type of heater.

GRAPHITE for February, 1913, announces that the Joseph Dixon Crucible Co., Jersey City, N. J., sent out the first parcels mailed from that city, one being sent to President Taft and the other to George T. Smith, president of the Dixon Company. Each contained the Dixon Company's Chrustmas box of pencils.

JENKINS BROS.' HEATING SPECIALTIES is the title of a conveniently arranged catalogue detailing some of the principal products of Jen-

kins Bros., 80 White Street, New York. Attention is called to this company's policy in valve construction, in which a margin for safety is allowed for the expansion and contraction of the radiators and piping, as well as possible abuse. To counteract this the valve bodies are notable for their strength substantial trimmings, high grade of steam metal used in their construction and careful workmanship. Special attention is given to the Jenkins Bros. standard fractional radiator valves for use with street steam systems, atmospheric systems, vacuum return line systems and vapor systems. The catalogue also contains details of the company's wood wheel gate valves, as well as its line of automatic impulse check valves and differential check valves. Size 4½ x 9¼ in. Pp. 32.

HAMMOND WATER METERS, with capacities of water per hour ranging from 12,500 lbs. to 300,000 lbs., are featured in a new bulletin, No. 100, published by the manufacturers, the Alberger Pump & Condenser Co., 140 Cedar Street, New York. The Hammond meter was designed for use under the exacting conditions found in the modern power station, making it possible to obtain accurate records of the water entering the boilers, and of the amount of condensed water from the engines or turbines. The company states that the difficulty of metering such water at its high temperature has been overcome in this apparatus. The Hammond meter is furnished in six sizes, with inlets ranging from 2½ in. to 10 in. The catalogue contains details as to dimensions as well as a technical description, with illustrations, of the meter's operation. Size 8½ x 11 in. Pp. 8.

VALVE WORLD for February, 1913, published by the Crane Co., Chicago, contains a timely plea for technical museums, an idea which is finding wide endorsement, and which would be particularly interesting in connection with the heating and ventilating trade.

DETROIT STEAM TRAPS, tilting tank type, which are now enjoying a wide use in connection with the company's other apparatus, are the subject of a new and elaborate catalogue issued by the American Blower Co., Detroit, Mich. These traps are made in two styles, the return type, to drain the heating coils, automatically returning the condensation to the boiler; and the separating type, to hold the steam in check and deliver the condensation to feed water heater, receiver, atmosphere, etc. In addition to illustrations of the company's numerous styles of this trap many typical installations are shown, accompanied by detailed instructions for their installation. Under Section 4 the catalogue contains additional typical installations and commendatory letters testifying to the trap's efficiency and satisfactory operation. Size 7 x 9 in Pp. 56.

ADVERTISERS' INDEX

Alberger Pump & Condenser Co..... 8
American Blower Co. 60
American District Steam Co. 8
American Radiator Co. .....Back Cover
Applied Heating and Ventilation 67
Armstrong Cork Co. 69
Armstrong Mfg. Co. 57
Bicalky Fan Co. 10
Binders for THE HEATING AND VENTILATING MAGAZINE 67
Bound Volumes, HEATING AND VENTILATING MAGAZINE 58
Bristol Co., The .....Front Cover
Buffalo Forge Co. .....Inside Back Cover
Carrier Air Conditioning Co. of America, Inside Back Cover
Central Station Steam Co..... 63
Chamberlin Metal Weather Strip Co..... 67
Chicago Pump Co. 67
Connersville Blower Co. 3
Davis Regulator Co., G. M..... 66
Dixon Crucible Co., Joseph 66
Dunham Co., C. A. 10
Fischer-Sweeny Bronze Co. Inside Front Cover
Foster Engineering Co. 68
Garden City Fan Co. 66
Globe Ventilator Co. .....Front Cover
Green Fuel Economizer Co..... 6
Gurney Heater Mfg. Co. .....Front Cover
Hackney Ventilating Co. 59
Harrison Safety Boiler Works..... 7
Ilg Electric Ventilating Co. 4
Industrial Instrument Co. 62
Jenkins Bros. 59
Johns-Manville Co., H. W..... 64
Knowles, Geo. E. .....Front Cover
Lavigne Mfg. Co. 57
Leiman Bros. 63
Marsh & Co., Jas. P..... 73
Massachusetts Fan Co..... 3
Michigan Pipe Co. .....Front Cover
Moline Vacuum-Vapor Co. 68
Monash-Younker Co. 56
Morehead Mfg. Co. 5
Mouat-Squires Co. 65
Mueller Mfg. Co., H. 70
National Steam Specialty Co. 65
Patterson & Co., Frank L. 74
Powell Co., The Wm. 58
Ric-Wil Underground Pipe Covering Co... 62
Ross Valve Mfg. Co. .....Front Cover
Sturtevant Co., B. F. 61
Thomas & Smith..... 63
Webster & Co., Warren 71
Wyckoff & Sons Co., A. 73
Zellweger & Sons, J. 72

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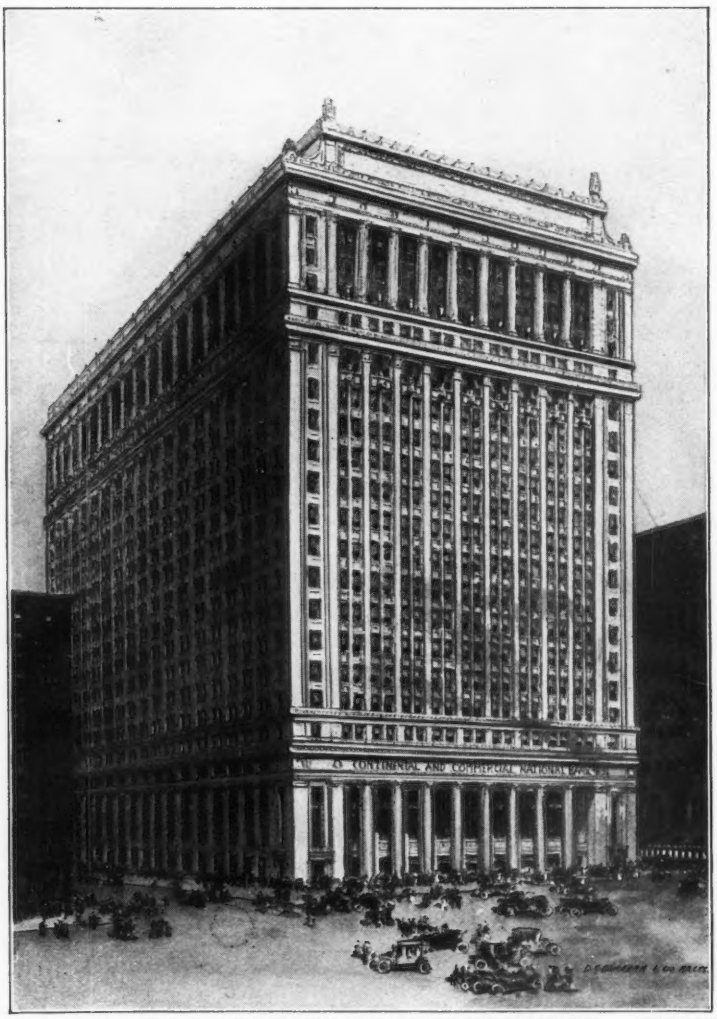

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